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ANNUAL REPORTS

OF THE

DEPARTMENT OF AGRICULTURE

FOR THE

FISCAL YEAR ENDED JUNE 30, 1902.

REPORT OF THE

SECRETARY OF AGRICULTURE.

DEPARTMENTAL REPORTS.

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REPORT

OF THE

SECRETARY OF AGRICULTURE.

REPORT

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To the President:

The educational work of the Department of Agriculture has grown in effectiveness since my last Annual Report. The opportunities offered to young men to fit themselves for special lines of experimental work under the immediate care of our most experienced scientists are being sought by greater numbers every year. The influence of the Department is extending through cooperation with the scientists of the experiment stations of the several States and Territories and the isles of the sea under our flag. The demands of these institutions for trained men to conduct research into so many fields of inquiry and of private individuals and companies for the best organizing and supervising ability to manage agricultural enterprises encourage students to prepare for doing this work.

The teaching of the science of agriculture and the sciences related to it is receiving more attention in the colleges instituted for this purpose, many of which in the past have neglected their full duty in this regard.

Research by the Department officials into the principles governing the growth of plants and the creation of new species by hybridizing to give varieties from which to select for new purposes has brought gratifying results. We have new fruits and grains of numerous kinds adapted to localities that have been needing them for many years.

We are helping people in many localities to an intelligent knowledge of their soils and of the most profitable uses to which they may be devoted. Results are showing the value of this service. The best sugar lands, rice lands, tobacco lands, truck lands, and lands best adapted to particular fruits, grains, grasses, legumes, and other crops are being discovered as certainly as any other unknown thing is brought to human knowledge for the first time.

Few of the plants of most value to our people are native to the United States. They are products of other countries and have been useful in their localities for long periods of time. Our various soils

and climates are adapted to many things that have not yet been introduced to them. Department explorers are searching the Old World for whatever is valuable there and useful here, with results that are quite encouraging. Our aims are to help toward the production in the States and Territories of everything their soils and climates will permit, and to help our new island possessions to grow whatever products require tropical conditions.

Our growing commerce is accompanied with danger from invasion of animal and plant diseases and parasites calling for vigilance on the part of Department scientists to keep them out and to deal with them when they cross our borders, as they occasionally do.

My last Report showed that the Department was paying $12,600 a year for rent of buildings. It is now paying $21,700, and the amount will increase as the work increases. It would be good business policy to adopt a plan of building adequate to the future needs of the Department, and to authorize the erection of so much of it as would provide for the offices that are now housed in the city wherever room can be had. The sum necessary to provide the rent, at Government rates of interest, would be ample to begin with; besides none of the buildings now in use are fireproof, and we have materials that have accumulated in our laboratories, in addition to a unique library, that could not be replaced if destroyed by fire.

WEATHER BUREAU.

Forecast Warnings.

The past year affords gratifying evidence of the value of forecast warnings of the Weather Bureau in saving life and property. People of other nations express appreciation of our Atlantic weather forecasts. The universal appreciation of this service in giving ample warning of the approach of severe storms or hurricanes or of killing frosts is highly gratifying and affords ample testimony of the assertion I have made on previous occasions that the value of property saved from loss repays to the country many times over the cost of maintaining the Bureau.

Substantial increase was made in the distribution of daily forecasts through the rural free delivery, although efforts in this direction were circumscribed for want of funds for the purchase of necessary supplies. On August 1, 1902, there were in operation about 10,000 rural free-delivery routes, serving approximately 1,000,000 families. For the reason stated, only 105,000 families, served by about 1,000 routes, could be furnished with the forecasts of the Bureau. According to the estimates of the Post-Office Department, there will be in operation July 1, 1903, 15,000 routes, serving approximately 1,500,000 families, representing a population of over 7,500,000 people. The distribution

of the daily forecasts of the Bureau should be made coextensive with the rural free delivery. This could be done on the basis of the Post-Office estimates for July 1, 1903, at a cost of about $100,000.

Wireless Telegraphy.

The experiments in space, or wireless, telegraphy were begun January 1, 1900, under the direction of the Chief of the Weather Bureau, and were continued during the past year. While much valuable information has been secured and a fairly satisfactory experimental system has been devised, I am not able to report such progress in the investigation as would justify the Department in dispensing with its coast telegraph lines or with the cables that connect certain islands with the mainland.

Storm Warning Equipment.

As far as funds would permit, the work of extending the equipment of steel towers and high-power lanterns of improved type at important storm warning stations was pushed energetically during the year by the instrument division. In all, 54 towers were distributed to storm warning stations.

The funds available were too limited to permit of the purchase of high-power lanterns and other accessories required by the towers. Moreover, the first six months of the past year have been necessarily consumed in the manufacture, shipment, and installation of the towers. The matter of lanterns and accessories will therefore have to be supplied this year, and while provision for them has already been made, the storm-warning fund will permit of no considerable extension of the work, and we must of necessity confine ourselves to finishing up the work left over from last year. There are now 109 storm-warning and 9 special stations at which the steel towers have been installed. Of these, 48 need lanterns, and they will be issued as soon as delivered by the contractors.

Under the special appropriation by Congress for the purchase of sites and the erection of buildings for the use of the Weather Bureau at certain stations, buildings were erected at the following places, at a total cost of $23,932.53, namely: Atlantic City, N. J.; Hatteras, N. C.; Fort Canby (North Head), Wash.; Port Crescent, Wash.; Tatoosh Island, Wash., and Point Reyes, Cal. Under this appropriation, also, buildings were repaired and improved and supplies provided, at a cost of $17,279.03, at the following places: Bismarck, N. Dak.; Jupiter, Fla.; Kittyhawk, N. C., and Cape Henry, Virginia. The buildings at Port Crescent, Wash., and Jupiter, Fla., are still in course of construction, but will be completed within a few months. In view of the approval of this policy and of the economy to the Government of owning its own buildings, I recommended an additional appropriation of $50,000, which

was duly granted by Congress, for the purchase of sites and the erection of not less than six buildings during the current fiscal year. The places selected for these new buildings are Yellowstone Park, Wyo.; Amarillo, Tex.; Modena, Utah; Key West, Fla.; Sand Key, Fla., and South Farallone Island, California. Owing to the difficulty in providing sites for the buildings at Amarillo and Modena, it will hardly be practicable to erect buildings there before next spring.

The crop service of the Bureau will be dealt with in a special report called for by Congress.

BUREAU OF ANIMAL INDUSTRY.

Inspection Service for Export Animals.

The act of Congress of August 30, 1890, provided for the inspection by the Bureau of Animal Industry of meats for exportation, and this was supplemented on March 3, 1891, by an act providing "for the inspection of live cattle, hogs, and the carcasses and products thereof which are the subjects of interstate commerce, and for other purposes." This law was amended by an act which took effect July 1, 1902, providing for the inspection of dairy products for export. Under these laws important service to the live-stock industry has been performed.

The total number of ante-mortem inspections was 59,158,648, being an increase over the previous year of 2,789,338. The cost of these inspections was 1.08 cents each. The number of post-mortem inspections was 38,903,625. The carcasses condemned numbered 61,980, besides 17,445 parts of carcasses.

The meat-inspection tag or brand was placed upon 19,694,665 quarters, 250,141 pieces, and 3,820 sacks of beef, 7,419,287 carcasses of sheep, 554,016 carcasses of calves, 1,253,083 carcasses of hogs, and 793,471 sacks of pork.

The meat-inspection stamp was affixed to packages of meat products that had received the ordinary inspection as follows: 7,166,490 of beef, 39,229 of mutton, 8 of veal, 15,835,520 of pork, and 638 of horseflesh, a total of 23,041,885.

The number of cars sealed containing inspected meat products for shipment to official abattoirs and other places was 64,730.

The number of certificates of ordinary inspection issued for meat products for export, exclusive of horseflesh, was 32,744. Of beef there were 1,571,305 quarters, 19,728 pieces, 3,845 bags, and 1,582,549 packages, with a weight of 416,990,762 pounds; of mutton there were 85 carcasses and 26,942 packages, weighing 1,145,248 pounds; of pork there were 94,962 carcasses and 658,139 packages, weighing 188,360,011 pounds. These figures show a decrease from the previous year of

35,839,611 pounds of beef and 42,784,927 pounds of pork. There were 11 certificates issued for horseflesh, the export consisting of 638 packages, weighing 170,968 pounds.

The quantity of pork examined microscopically, which was exported, amounted to 33,681,229 pounds. This was a decrease of a little more than 2,000,000 pounds from the previous year, owing to a decreased demand for pork from those countries demanding inspection. The cost of this work per pound was 0.368 cent.

The value of the exports of animals and animal products for the year ended June 30, 1902, amounted to the large sum of $244,733,062. Of this amount, $44,871,684 was the value of the animals, $192,756,608 of the meat and meat products, and $7,104,770 of the dairy products. The total value of the exports of animal products was about $3,000,000 greater than the like exports of the previous year, but there was a decrease of nearly $8,000,000 in the value of cattle exported. This was due to the sharp demand for beef cattle in this country.

Of the 392,884 cattle exported, 295,346 were inspected, tagged, and certified as to health. The others shipped were from ports where inspection is not provided and is made to countries where a Government certificate of inspection is not required. Of sheep, 401,132 were inspected and 212,178 were certified for export; of horses, 19,990 were inspected and 10,975 certified for export. The value of the cattle exported was $29,902,212; of horses $10,048,046; of mules $2,692,298; of sheep $1,940,060.

The inspection of vessels for carrying live stock has been conducted with a view to the best possible service and the most humane treatment of the animals. The percentage of loss in ocean transit of cattle is now reduced to 0.13 for cattle, 0.89 for sheep, and 0.65 for horses.

The number of clearances of vessels carrying live stock was 837, which was considerably less than for the previous year—a condition due to the decreased exports of cattle and horses.

Inspection Service for Import Animals.

There were inspected and admitted from Mexico 65,213 cattle, 3,776 sheep and lambs, and 2,090 goats; also a few asses, horses, mules, and hogs. Through ports on the seacoast, horses not subject to quarantine were imported to the number of 2,283.

One of the most important duties of the Bureau of Animal Industry is to maintain strict quarantine at the ports of the seacoast in order to prevent the introduction of animal plagues. The efficiency of this service has been shown in the past, and it is a service by which the live-stock interests of our country are directly conserved. The live-stock growers demand and receive the most rigid inspection at these ports, for it would be no difficult matter to permit the introduction of diseases which might easily cost the live-stock growers many millions

in direct losses, and at the same time the Government would be under heavy expense in efforts toward their eradication.

We imported from Canada 27,716 cattle, 148,313 sheep, 3,305 horses, and 5,356 hogs which were not subject to quarantine. There were also imported and quarantined 1,214 cattle, 231 sheep, and 33 hogs. Besides these there were quarantined animals of various species which were destined for menageries and zoological parks.

For the purpose of preventing the importation of cattle affected with tuberculosis a veterinarian has been stationed in Great Britain, whose duty it is to test with tuberculin all cattle over six months old which are destined for export to the United States. During the year 1,067 cattle have been so tested, of which 928 were passed and 139 rejected. These cattle were representatives of nine different breeds, those predominating being Hereford, Jersey, and Shorthorn.

Exports of Dairy Products.

Experimental exports of dairy products have been made to Japan, China, Cuba, and Porto Rico. This method of making known the better grades of these products has resulted in somewhat increased sales by merchants in San Francisco and New York and some parties elsewhere; but inadequate and unsuitable transportation facilities, the destructive climates of some of the markets referred to, and other unfavorable conditions prevent any rapid increase in this trade. The results indicate, however, that the markets of Japan may be further cultivated.

Under act of Congress of March 2, 1902, the dairy division of the Bureau inaugurated a system of inspection of dairy products offered for export, affixing stamps to the same, and certifying to the character and quality of the articles. Domestic prices, however, have been so high as to prevent any considerable export of high-grade goods other than condensed milk and cream.

Contagious Diseases.

The work of this Bureau with reference to contagious diseases of animals, which has been prominent from the time of its organization, has been continued. This work at present includes the control of Texas fever, blackleg, sheep scab, and maladie du coït, while scientific investigations are in progress to determine the nature and best methods of treating other important diseases, such as tuberculosis, hog cholera, and anthrax. The records show that 1,688,565 doses of blackleg vaccine were distributed during the year, and the reports of its use reduce the loss of cattle after using it to 0.51 per cent of those vaccinated. If we should eliminate from these reports those cattle which were presumably infected before vaccination, and also those

which probably died because a mistake was made in the operation, the percentage of loss would be reduced to 0.44. These results indicate that the use of this vaccine has saved to the stock raisers many thousands of head of cattle and consequently a very large sum of money.

BUREAU OF PLANT INDUSTRY.

In accordance with the recommendations in my last report, Congress brought within the scope of this Bureau four additional lines of plant work, viz, the Arlington Experimental Farm, the investigations in the production of domestic tea, the work on foreign seed and plant introduction, and the Congressional seed distribution. It has necessarily required much time to perfect this reorganization, but everything in this direction is now practically complete and the nine main branches of the Bureau are being so conducted as to bring forth the very best work. Much of the success of any work in the Department depends, in the first place, upon good men, and, in the second place, upon giving such men responsibilities of a nature that will develop their best efforts. This policy is followed in the Bureau of Plant Industry, and as a result there is an earnest corps of workers, each knowing his duty and performing it with all the energy at his command. Owing to the fact that much of the detailed work connected with the reorganization was completed last year, it has been found practicable the present year to devote considerable attention to the development of new fields, a few of which may be briefly referred to here.

The nature of the work of this Bureau is such that cooperation with the State experiment stations is an important factor, and for this reason very close relationships have been established with station investigators in about thirty States. The work undertaken conjointly with these stations is of the most varied character.

Farm Management.

As the work of reorganizing this Bureau developed, the need was felt for properly coordinating all the varied lines of plant work in such a way that they could be brought directly home to the practical farmer and fruit grower in all parts of the country. To this end, I have approved the establishment within the Bureau of an office of Farm Management, which shall have for its object the bringing together in concrete form of all the facts developed in the Bureau as a whole, sifting the results, and applying them in a practical way where they will do the most good. To enhance the value of this work general studies have been inaugurated in the matter of securing facts regarding the way in which the best paying farms in the country are being managed, and what are the relationships of surrounding conditions, such as proximity to markets, ways of leasing or controlling the lands, soils,

and climate, and the methods of farming followed. With the knowledge thus secured it will be practicable to lay out a working plan for a particular farm in a particular region, the object being in all cases to have such plans serve as object lessons for type regions rather than for individuals. In line with this plan there is now being undertaken in different parts of the South demonstration experiments for the purpose of showing the possibilities of more diversified farming.

With the cooperation of farmers, working plans are being devised whereby the present system of growing only one crop will be changed so as to secure more diversification, thus insuring greater profits and the building up of the fertility of the land. There are many thousands of acres in the South where the same system of farming has been carried on for years and where it would be a great advantage to inaugurate changes which would lead to the building up of the fertility of the soil and give broader opportunities to those handling the same. As a specific example of this work there is now being developed in the South, as object lessons, a system of what will be called "one-man" farms. These are small areas of land in the pine woods region upon which a system of farming is being developed of such a nature as to appeal directly to the class of farmers who must necessarily handle such land. Instead of a single crop, simple systems of rotation are being put into operation, and the question of the proper stock to keep is being considered, all being of such a nature that the work can be handled by one individual. In other regions, where the conditions are different, more elaborate plans are under way whereby considerable tracts of land which have for years been cropped to cotton are being arranged for a regular rotation, introducing stock as an element for the purpose of showing the possibilities of such diversification and its bearing on the welfare of the different communities.

Extension of Fruit Markets Abroad.

With the increasing production of special crops there is felt the urgent need for broader markets. This is particularly the case with perishable products, such as fruits and certain kinds of vegetables. There have lately been undertaken, in a limited way, some investigations having for their purpose the extension of the export trade and the improvement of the methods of handling these products for foreign and domestic use. Several experimental shipments have included summer apples, peaches, fall pears, and sweet potatoes—products in which an export trade is undeveloped; and winter apples, in which there is a large and increasing trade, but in which it is desirable to bring about improvements in the methods of handling and shipping.

The results so far obtained indicate that the first-named products may be landed in European markets in good condition if proper care is exercised in all of the operations from the orchard or field to the

final destinations. A net return has been realized equal to, and in most cases in excess of, domestic values. It is shown also that the net return for a given fruit is largely influenced by the kind of package in which it is forwarded, and by the methods of packing and shipping it.

These preliminary investigations have already encouraged growers to ship some of these fruits in a commercial way and to adopt the suggestions brought out by the Department investigations. The fruit export trade needs careful investigation, both at home and abroad, in order that the methods of the American fruit grower may conform more closely to the foreign practices of handling and distributing our fruits and to the requirements of the foreign consumer.

I wish here to point out the necessity in work of this kind for a thorough and systematic study of the different foreign markets, in order that the American farmer and fruit grower may act intelligently in making shipments. To this end a plan is being devised whereby an experienced man will be sent to one or more of our most promising foreign markets to study all the prevailing conditions, and to secure and handle experimental shipments of fruits and vegetables, noting the condition in which various shipments arrive, the methods of packing which give the most satisfactory results, and looking after numerous other details which can be determined in no other way. Such an agent would also be in a position to secure valuable facts regarding the products with which we are compelled to compete, and would be able to point out methods by means of which we could best meet this competition.

To make this work still more valuable, the Department's agent or agents could do much toward enlightening the general public in such foreign countries in regard to the value of our products for general consumption. There is no reason why many of our fruits and vegetables can not be sent abroad and sold at a price that would place them within the reach of the average consumer, provided he was aware that he could obtain them, and knew something of their value as food. In other words, it seems that the time has come for decisive action in the matter of exploiting abroad such products as have been mentioned; and to accomplish this with the best results trained men, and men of good judgment, will be required. If sufficient funds are available, it is planned to inaugurate this work the forthcoming year in a limited way.

Plant Physiology and Pathology.

The practical utility of thorough scientific investigation of agricultural problems is nowhere better demonstrated than in the Department's work in the broad field of physiology and pathology. While the greatest scientific accuracy is demanded on the one hand in the study

of the normal and abnormal or diseased condition of plants, on the other hand no effort is spared to make the knowledge thus obtained of practical use. Following are some of the results of the work of the past year.

PLANT DISEASES.

PEAR BLIGHT.

This disease, also known as fire blight or apple blight, is the cause of heavy losses annually. It has been especially severe for the past two years in the Southern and Pacific Coast States. The Department several years ago discovered improved methods of treating this disease, and during the past year a large field demonstration of the method was made in Texas in a place where the disease was so severe as to thoroughly test the treatment. This experiment, on a commercial scale, was entirely successful. Four to five thousand bushels of fruit were saved in the treated orchard, while in the untreated adjacent orchard the fruit was destroyed by the disease and the trees greatly injured. Similar demonstrations will be carried out next year in other parts of the United States.

LITTLE PEACH.

Some important discoveries were made during the year in regard to this rapidly spreading disease. In some respects it appears to be almost as serious a trouble as the dreaded peach yellows, and, as in the case of that disease, the Department recommends immediate destruction of the diseased trees. If this is promptly done the disease may be largely stamped out. No resistant stocks have yet been found, though careful search is being made for them.

BITTER ROT OF APPLES.

This disease is one of the worst with which the apple grower has to contend. For the past three years it has destroyed millions of dollars worth of fruit on the trees and millions of dollars worth in the hands of commission men. The method of treating this disease has, in the past, been only partially successful. An agent of the Department has lately discovered that the infection spreads from diseased canker spots on the limbs to the fruit. This discovery will enable us to much more thoroughly control the disease, if not to prevent it entirely. The spraying experiments this year have also been very successful.

BACTERIAL DISEASE OF ENGLISH WALNUTS.

One of the most important industries of southern California is the growing of English walnuts. For several years a disease has been gaining headway in the orchards and has caused great loss. The

Department's experts on the Pacific coast have been studying the trouble and have been especially successful during the past year in improving the methods of combating it. While much still remains to be accomplished, a treatment has been found which will greatly reduce the injury done by the disease.

DECAY OF FOREST AND CONSTRUCTION TIMBER.

Rapid progress has been made during the year in the study conjointly with the Bureau of Forestry of the diseases of forest trees. Special attention has been given to the diseases in the great forest reservations, and practical methods of controlling some of them have been devised.

Recently a serious heart-rot disease of catalpa has appeared in some of the western catalpa plantations. A Department expert has studied this rot fungus, found out what it is, and has devised a method to protect the trees against it in the future. The importance of this is apparent. The planting of catalpa groves is increasing in several of the Western States. The wood is very durable, making good fence posts, telegraph poles, etc.

One of the most important subjects connected with the utilization of forests is increasing the durability of wood when used for construction. A careful study of the various methods of preserving wood was begun the past year by Department experts and much valuable information obtained. The organisms causing decay of fence posts, sills of buildings, railroad ties, telegraph poles, bridge timbers, greenhouse benches, etc., practically all belong to the group of fungi. The Department believes that cheap and effective methods of treating lumber so as to prevent this decay can be found, and considerable progress was made in this direction the past year.

PLANT BREEDING WORK.

DISEASE-RESISTANT CROPS.

The most practical way to fight disease is to use nature's method and get disease-resistant or immune plants. Striking success has been achieved by the Department experts in this line. The development of cotton resistant to wilt disease is now an assured fact and has been taken hold of by the planters on a large scale. Large tracts of land in the Sea Island district of South Carolina which had been abandoned on account of this disease were planted the past year successfully with resistant strains of cotton, and good crops secured. The discovery during the past year of a variety of cowpea—"Little Iron"—resistant to "wilt" and "root-knot" (two of the worst diseases of this important crop in the South) is a matter of great importance to Southern agriculture, where the need of leguminous crops for forage and

soil improvement is especially felt. Thirty bushels of seed of this resistant variety were distributed during the past year.

Satisfactory progress was made during the year in securing varieties of cotton resistant to the Texas root-rot, and some evidence was obtained that varieties may be developed resistant to the dreaded cotton boll weevil.

BETTER UPLAND COTTONS.

One of the greatest needs in improving the cotton industry of the United States has been to secure a long-staple Upland variety which is of good quality and productive.

The long-staple Upland varieties at present existing are all of them rather light producers, and are defective in that the fiber is borne on fuzzy or tufted seed, which makes them difficult to gin.

The aim of the Department's experts has been to secure productive varieties with large bolls, easy to pick, with fine, strong lint from $1\frac{1}{4}$ to $1\frac{3}{4}$ inches long, borne on a smooth black seed. Many hybrids were made with this in view and the result has been successful beyond our expectations. Several varieties of the ideal type desired have been produced, having larger bolls, very productive, with long, fine fiber, borne on smooth black seeds. The experiments of the past year show quite conclusively that these varieties can be made permanent.

Egypt and South Africa are waking up to their possibilities in cotton production, and they are already endeavoring to get some of our experts to help them to develop the industry in competition with the United States. The only way we can continue to maintain our supremacy in the future is to develop and grow better and more productive varieties than will be grown by our competitors.

HARDY ORANGES.

The work of developing frost-resistant oranges was started several years ago, and the progress of the work has been reported from time to time. During the past season we have obtained the first fruits of these hybrids. These are intermediate in character between the Florida sweet orange and the hardy trifoliate, and have good, though few, seeds. There is therefore strong probability that from the seeds of these fruits we shall obtain numerous varieties with the qualities desired.

WHEAT BREEDING.

Several of the Russian winter wheats are superior to the American varieties; still there is room for improving on the Russian varieties. As a rule Japanese varieties are early maturing, while the better Russian sorts are late. Hybrids between the Japanese and Russian varieties have already been obtained having the good qualities of the hardy Russian sorts and the early ripening quality of the Japanese. Early

varieties often escape the worst periods of drought and are less likely to be injured by rusts and other fungous and insect pests. Gratifying progress has also been made during the year in breeding rust-resistant varieties and nonshattering sorts.

NITROGEN-GATHERING BACTERIA.

Attention was called in my last report to the importance of nitrogen in the nutrition of plants, and the discovery of a new method of cultivating the bacteria which gather nitrogen in connection with leguminous crops was announced. This method has been perfected during the past year. The reason for the failure of former work in this line, both in this country and Europe, has been determined, and a new, simple, cheap, and thoroughly satisfactory method of growing and distributing the tubercle bacteria for all the important leguminous crops has been perfected. The nitrogen-gathering power of the bacteria grown by our new method is at least five times as great as the nitrogen-gathering power of the ordinary forms found in nature, and the new forms, instead of being restricted to certain legumes, have a much wider range of activity. Field tests on a large scale were started during the year, and advance reports from the cooperating farmers show extremely favorable returns from the use of these organisms.

Botanical Investigations and Experiments.

During the year the botanical investigations of this Bureau were pushed forward with vigor. Some of the more important results accomplished in this field are outlined below:

THE COMMERCIAL GRADING OF GRAIN.

A movement to secure an improvement in methods of inspection and toward greater uniformity in work of inspection departments of the large grain markets is now well begun, as a result of an organization of the chief inspectors of these markets. The interest manifested in this movement by all branches of the grain trade gives reason for believing that there may result from it a system of inspection and grading, maintained by the trade organizations, which shall be honest, efficient, and uniform throughout the country, and which shall insure to the farmer a premium for high quality of product, and to the consumer the quality of grain he demands and pays for. The Department is aiding this movement as much as possible by cooperating with these chief inspectors in working out simple and practicable methods for determining and accurately stating the quality of grain and studying causes and methods of prevention of deterioration of grain in storage and in transit.

AMERICAN AND EUROPEAN RED CLOVER SEED.

The study of the merits of red clover of American as compared with that of European origin has been continued, with the cooperation of a number of agricultural experiment stations in the clover-growing States. From the 1901 plantings the results were practically the same as those of the year before in the testing garden at Washington. The European clovers were not able to stand the hot and dry periods of our summer, but suffered badly from sun scald, and were generally of a much lighter color and less thrifty than those from our own seed. The same facts hold true for the plantings made this year, and it is evident that the European clover, unless it be some from the extreme north, is not adapted to the clover-growing sections of the United States.

NEW REMEDY FOR SHEEP POISONING ON THE STOCK RANGES.

The great stock ranges of the Northwest contain approximately one-third of the sheep in the United States, representing a value of more than $40,000,000. The owners of these sheep suffer an annual loss conservatively estimated at 1 per cent, or $400,000, from poisonous plants. During the past year the Department has continued its investigation of this loss and has succeeded in isolating poisonous principles from the species of camas and from one of the lupines, the two kinds of plants which, next to the loco weeds, cause the greatest percentage of loss in the Northwest. The antidote for poison camas announced by the Department in 1900, viz, drenching with a 1 per cent solution of permanganate of potash and sulphate of aluminum, while effective, can be successfully applied by one man to only a few sheep. Some remedy was demanded which could be more quickly applied when a large number of sheep are poisoned. Our physiological tests of the active principle of poison camas on rabbits and other small animals, subsequently verified with sheep, showed that considerable quantities of the poison passed from the system in the urine. A series of tests was then instituted with drugs that are known to stimulate the action of the kidneys. It has now been demonstrated that a combination of diuretin and caffeine is a satisfactory antidote for this poison; and as it can be given very rapidly by means of a hypodermic syringe, one man can apply the remedy to several hundred sheep in a few hours.

AN IMPORTANT STEP IN HEMP CULTURE.

More than nine-tenths of the hemp produced in the United States is grown in Kentucky, and at present prices it is regarded as second only to tobacco in profit as a farm crop. It yields a good profit there, notwithstanding the fact that practically no labor-saving machinery or

improved methods of handling the crop have been introduced. The hemp is nearly all cut by hand, and after much laborious handling in the process of curing and retting it is broken on a hand brake. In Nebraska, where the industry is being established, a new and important step has been taken in cutting the crop with an ordinary mowing machine. A simple attachment, which bends the stalks over in the direction in which the machine is going, facilitates the cutting. The work is regarded as not much more difficult than that of cutting clover or alfalfa, and one man with a span of ordinary farm horses and a mowing machine that has a 5-foot or a 6-foot cutting bar will mow about 10 acres per day. The cost of cutting hemp in this manner is 50 cents per acre, as compared with $3 to $4 per acre, the rates paid for cutting by hand in Kentucky.

The hemp, after being mowed, is left where it falls until retted, except where it is especially heavy. In that case it is necessary to turn it to secure uniformity in curing and retting. It is then raked up and taken to the mill, where the fiber is extracted by means of a series of fluted rollers and beaters. By these methods hemp tow is produced nearly equal in value to Kentucky rough hemp, and at a total cost, exclusive of rent of land, of about $20 instead of $45 per ton.

THE UTILIZATION OF FLAX STRAW.

Efforts are being made to utilize the fiber contained in the thousands of tons of flax straw produced from the flax raised for seed in the Dakotas and Minnesota. Heretofore most of this straw has been burned to get it out of the way. Now large quantities, after being cut and thrashed in the ordinary manner, are subjected to a breaking process which produces a fiber of excellent quality for paper pulp and also a fair grade of fiber for textile purposes. During the past season satisfactory results have been obtained in the use of North Dakota flax for the manufacture of binding twine.

DEVELOPMENT OF THE SISAL INDUSTRY.

The demand for sisal for the manufacture of binding twine is rapidly increasing, owing largely to the advent of the corn binder. The sisal plant is very exacting in regard to the conditions under which it may be cultivated successfully, and, as the areas having the proper conditions for its growth are comparatively limited, it is of the utmost importance to our American consumers of binding twine, as well as to the fiber producers in our tropical territories, that land suitable for the growth of the sisal plant be utilized so far as possible. These facts have been accentuated by the high prices paid for sisal fiber during the past year. A brief investigation has been made of the sisal industry in the Bahamas, where the conditions are somewhat similar to those in

Porto Rico. Some sisal plants from the Bahamas have been sent for trial to the Porto Rico experiment station at Mayaguez. There seems to be little doubt that the sisal plant can be successfully cultivated in limited areas in Porto Rico, as it is now being cultivated in Santo Domingo. It has been introduced into Hawaii, and the first commercial crop has been harvested there during the past season, the fiber produced finding a ready market at good prices in San Francisco.

THE MANGO AND ALLIGATOR PEAR IN PORTO RICO.

Reports are in preparation advising the extensive planting of superior varieties of mangoes and alligator pears in Porto Rico, to supply the increasing demands of the markets of our Eastern cities. That these fruits are not already as popular in the United States as bananas and oranges is due to the fact that there has been no adequate or regular supply of good quality. Porto Rico offers natural conditions very favorable for their culture, and improved facilities of transportation have simplified the commercial problem. Varieties much superior to those now grown for home use in Porto Rico have been found by representatives of the Department in Guatemala and Mexico.

CULTURE OF THE CENTRAL AMERICAN RUBBER TREE (CASTILLOA).

It is generally supposed that a continuously humid climate is necessary for rubber culture, but in southern Mexico it is obvious that an alternation of distinct wet and dry seasons is favorable to the production of rubber by Castilloa, which will permit a much wider use of this tree in our tropical islands than has appeared possible hitherto. The failure of some of the earlier experiments may be ascribed to planting in situations too uniformly moist. The tree will often grow luxuriantly where it will produce little or no rubber, as many planters have learned to their cost. Rubber is the most important vegetable raw material now imported for manufacture in the United States. The agricultural production of rubber is assured, and several millions of capital from the United States have been invested already in Mexican rubber plantations. The extent, however, to which these and similar enterprises in other countries can be made profitable depends on the solution of many new agricultural problems.

COFFEE SHADE.

The coffee industry of Porto Rico has been injured by the presence of too many shade trees in the plantations, owing to the belief of the planters that heavy shading is necessary. A study of the flourishing coffee industry of Guatemala establishes the facts that coffee of the highest grade can be grown entirely without shade, and that the diminution of shade lessens the ravages of the Central American leaf dis-

ease. The general opinion that the foliage and fruit of the coffee shrub are benefited by shade is erroneous, but the shading of the ground is often a cultural advantage. The nitrogen-collecting powers of leguminous shade trees have also contributed largely to the good effects commonly ascribed to shade, so that the selection of the best leguminous shade trees and soiling crops is of much importance to the coffee planter.

Pomological Investigations.

Fruit growing is the dominant type of agriculture in many parts of the country. Formerly it was an incidental feature of farm management. Now enough of certain kinds are grown for domestic use, and a large export trade has been developed. America grows fruit on an extensive scale in contrast with the small, garden-like areas of Europe. In America fruit is a common article of diet; in European countries it is a luxury. Europeans are beginning to know and value American fruits, but the principal consuming population of Europe is yet unacquainted with them. There are great possibilities in the export trade.

Domestic practices in culture and in methods of handling and marketing fruits are in need of improvement. Greater knowledge concerning the adaptability and distribution of varieties is urgent, and knowledge concerning the adaptability of European fruits to American conditions is desirable. Along these lines the pomological investigations of the Department have been largely proceeding since my last report, and in the office the great mass of scattered information on pomological matters and pomological collections is being systematized for practical use.

The Cold Storage of Fruits.

Cold storage, or refrigeration, is a necessary adjunct to the rapidly developing fruit interests of the country. There is little known about the influences which govern the keeping qualities of fruits and vegetables. The Department is investigating this subject, and has strong support from fruit growers, fruit handlers, and warehousemen. The Bureau of Chemistry is cooperating with the Pomological Investigations in studying the chemistry of fruit-ripening processes. The investigation will require several years to secure general conclusions, but already important commercial results have been obtained.

"Scald," or a skin discoloration, is one of the serious storage difficulties with many apples. The cause is yet undetermined, but the investigations indicate that the susceptibility can be largely reduced by allowing the apples to become more highly colored or more mature than usual before picking. Such fruit also keeps equally well in storage. Pears and peaches, though usually stored with difficulty in a temperature of 36°, keep much better in a temperature not above 32°.

Fruit, like Bartlett pears and peaches, that ripens quickly after picking, and which is stored for a short time only, keeps best in open packages in which there is a free circulation of air which quickly reduces the temperature of the fruit; but winter apples, to be held for a long period, keep best in a closed package, which prevents evaporation from the fruit. The Department is investigating the influence of cultural conditions, methods of transportation, and systems of refrigeration, and the results seem likely to clear up many of the present cold-storage difficulties.

VITICULTURAL INVESTIGATIONS.

The viticultural investigations of the Department relate largely to the introduction of European table grapes into the Southern States, to various problems connected with the propagation of European and native grapes, and to the manufactured products of the grape.

In the experimental vineyard of European varieties at Earlton, Fla., established in 1899, several varieties are very promising and seem worthy of commercial planting in a restricted way. In this vineyard, which is on sandy soil, the distinct superiority of stocks of the Rupestris type over Riparia stocks has been demonstrated for the Vinifera varieties.

In North Carolina the experimental vineyard of similar varieties shows several promising varieties, though the results are less encouraging than in Florida.

An extensive experiment in bench and field grafting of Vinifera grapes has been begun to determine the relative congeniality of different varieties to different resistant stocks and the behavior of the grafted vines on various kinds of soils. This work is planned to have distinct bearing on the grape industry of the South and of the Pacific coast.

An investigation of the influence of dipping grape cuttings in water at different temperatures and for varying lengths of time upon their growth, and to destroy the Phylloxera, has demonstrated that the limit of safety was reached in a temperature of 50° C. with a five-minute immersion.

Investigations are also in progress relating to stocks that are resistant to the Phylloxera, and which are adapted to the grape growing of the Pacific coast.

The Department is also making a careful study of the methods of manufacturing unfermented grape juice and of its importance as a commercial product.

FRUIT DISTRICT SURVEY.

The adaptability of varieties to the conditions under which they are grown is a matter of fundamental importance, and no question is more

often asked by a prospective fruit grower than "What varieties shall I plant?" The object of this survey is to determine the varieties of the different fruits best suited to the conditions where they are to be grown and to study the influence of conditions upon the behavior of varieties.

The funds available for this work have made it possible only to survey some of the more important sections of the Piedmont region of Virginia, the Blue Ridge section of Maryland, and a portion of a similar area as it extends into Pennsylvania. Much important data regarding the behavior of the numerous varieties of fruits already grown there have been accumulated. This survey is being extended to other fruit-growing sections as rapidly as possible.

In connection with this work an extensive cooperative system of phenological observations has been established. It is expected that these observations, extended over a period of several years, will throw light on several perplexing questions regarding the behavior of varieties and their adaptability to the various fruit-growing regions.

SPECIAL PROBLEMS IN POMOLOGY.

Investigations are well under way with pomological problems connected with the pecan industry, the peach industry, and the citron of commerce industry of the Pacific coast. On all these lines there is a large demand for reliable information, and the Department is preparing to issue publications covering them.

Grass and Forage Plant Investigations.

The value of the hay crop in this country exceeds that of any other crop except corn. When we add the yield of pasture lands to that of hay fields, the total exceeds the value of even the corn crop. Investigations of grasses and forage crops are therefore of vital importance to American agriculture. The investigations in this line during the past year have shown that the maintenance of soil fertility is intimately associated with the production of forage crops and their proper utilization on the farm. Those States which are noted for the production of such crops not only have maintained the original fertility of the soil, but they spend for commercial fertilizers less than 1 per cent of the annual value of their crops, while those States which pay least attention to forage crops have impoverished the soil and spend annually for fertilizers from 5 to 9 per cent of the total value of their crops.

LEGUMINOUS FORAGE CROPS.

The influence of leguminous forage crops in restoring fertility to the soil is well known. No system of agriculture can be indefinitely maintained without some crops of this character. From the earliest

times clover has been the foundation of agriculture in our Northern States. But with each succeeding year the difficulty of securing a stand for this important crop increases, and there is a pressing demand for a suitable substitute for clover. The Department has undertaken to meet this demand by the introduction of alfalfa in the clover region. The success which has thus far attended our efforts in this direction is most encouraging. It has been demonstrated that alfalfa can be successfully grown in nearly all the Northern States. This work promises so much that we desire to push it vigorously during the coming year.

In our Southern States the cowpea is deservedly popular as a leguminous crop, both on account of its feeding value and its beneficial effect on the soil. But on account of its habit of growth this plant is difficult to harvest, either for hay or for seed. The Department has collected all known varieties of cowpeas in order to study the characteristics of each. We have undertaken to produce varieties that shall be free from the objectionable characteristics of those now grown, and have reason to hope for complete success. Other leguminous forage crops are being tested, both at Arlington Farm and at various places in the several States. Among these is a new and promising variety of alfalfa from South America that resists the rust which frequently attacks the common form, and which grows taller than the latter. As soon as seed of this variety can be obtained in quantity it will be distributed in those sections where there is most need of it.

GRASS GARDENS.

The grass garden on the Department grounds has been improved in a number of ways, and contains a large number of valuable grasses, legumes, etc. During the year this garden has been visited by a large number of people interested in agriculture, who have thus had an opportunity of observing many forage plants new to them. The public has shown a lively interest in this valuable display, which includes several valuable lawn grasses and ornamentals. An extensive grass garden was also maintained by this Department on the grounds of the Exposition at Charleston, S. C., and the correspondence received from Southern farmers relating to this garden shows that it was considered one of the most valuable features of our exhibit. It has been the means of introducing several new forage plants in the Southern States.

RANGE IMPROVEMENT.

The investigations in this branch of work have shown that the depleted Western ranges may be brought back to their original productiveness by proper methods of range management. Heretofore this work has been confined to small experimental areas. We have now progressed to the point where it becomes necessary to cooperate with

stockmen in the actual management of selected areas of range lands. To do this it is necessary that we control the grazing of stock on such areas. To this end I repeat my former recommendation, namely, that action be taken by Congress giving you, Mr. President, authority to secure for the experimental needs of this Department such tracts of public range lands as may be necessary for the best interests of the work.

SOIL AND SAND BINDERS.

Along the Atlantic and Pacific coasts and the shores of the Great Lakes, as well as in many inland places, there are to be found extensive areas of drifting sand. These shifting dunes of sand frequently destroy farms, cover up farm buildings, and interfere with the operation of railroads. The Department is engaged in investigations having in view the covering of these sand dunes with vegetation to prevent drifting. Several species of plants have been found that can be propagated rapidly in this drifting sand. Several successful plantations of these have been made, and others are now being made. Some of the leading sand-binding grasses are grown on an artificial sand dune in the grass garden on the Department grounds, forming a very instructive feature of our outdoor exhibit. From the results thus far secured in other countries we have reason to hope that we may finally bring these barren and dangerous sands into useful grass and wood lands.

CROPPING SYSTEM.

This Department is collecting data concerning the systems of farm crops used in various parts of the country, in order to study the relation of such systems to the maintenance of soil fertility. The data already at hand show that in those sections where a one-crop system prevails the soil rapidly loses fertility, and there is a large and increasing demand for commercial fertilizers, while in those sections where a system of rotation of crops prevails, particularly a rotation including forage crops to be fed on the farm, the soil continually improves, and commercial fertilizers are not used except on small areas for special crops. I believe that this Department can do much for agriculture in this country by devising suitable cropping systems for those sections where present systems are unsatisfactory, and giving the farmer information about the best methods of utilizing his crops.

HORTICULTURE.

EXPERIMENTAL GARDENS AND GROUNDS.

As pointed out in my last report, the Experimental Gardens and Grounds under the reorganization have been made exceedingly useful as an aid to other branches of work carried on by the Bureau of Plant Indus-

try and other Bureaus in the Department. With a view to still further increasing the value and efficacy of this work, investigations have been inaugurated having for their object the securing of information on crops which are cultivated more or less intensively in various parts of the United States. Special attention has been given to the cultivation of plants under glass and the elucidation of problems having a bearing on this important industry. The Experimental Garden is one of the oldest branches of the Department, and since this work was inaugurated a great many valuable plants have been accumulated. These have not been made as available for study as they might be, and for this reason plans have been put in operation whereby the various collections on the grounds and in the greenhouses will be brought together, properly labeled, and made useful for visitors and others who wish to study them.

A special feature of this work will be the development on the grounds of gardens of economic plants. It is planned to bring together a considerable number of the various native plants of the Eastern United States for the purpose of showing the possibilities of utilizing these plants in the simple decoration of the home and of schools. It is also planned to develop various collections of economic plants, such as drug and medicinal plants, and plants used in the arts and for numerous other purposes. As a further line of work for this branch of the Department, plans have been put in operation for securing and distributing seedling trees which have more or less historic interest. There are many historic trees in the vicinity of Washington and in the country at large, and it is believed that much good can be done toward arousing an interest in tree planting by distributing a limited number of these trees under proper direction. The seedlings, when grown, will be sent to schools in various parts of the country, and there will accompany each tree a concise statement setting forth the historic events connected with the tree itself and the growing of the seedling. The primary object is to keep alive patriotism and to encourage a love for nature and a love for home and the habit of tree planting.

THE ARLINGTON FARM.

The work on the Arlington Farm during the past year has been greatly increased. A considerable portion of the land has been drained, and during the year a thorough survey was made and the ground was platted, so that it was found practicable to begin the real work of experimentation. This farm, previous to its acquisition by the Department, was used for many years as a grazing area for horses and mules not in service, belonging to the War Department. In general it was fairly well covered with blue-grass sod, but many shrubs and trees had grown up to interfere with cultivation. The trees and shrubs were removed, the sod plowed and put into condition for the

reception of cowpeas or buckwheat, according to the condition of the area, and the work was completed. About 40 acres of the land which in 1901 were planted in cowpeas were this year devoted to plat work. The plats are uniformly one-twentieth of an acre in area. Some 4 acres of such plats are devoted to nursery purposes, including seedling forest trees, while the rest is given over to experiments with vegetables, plant-breeding experiments, experiments conducted by the Pathologist and Physiologist, Pomologist, etc. In surveying and platting the land the location of barns and future buildings was determined upon, and a barn suitable for important needs is being constructed at the present time. With the facilities at hand it will be practicable next season to inaugurate quite extensive work.

Tea Growing in the United States.

The work on the growing of American tea was continued during the year at Pinehurst, Summerville, S. C., in cooperation with Dr. Charles U. Shepard. Dr. Shepard now has at his place about 100 acres in tea gardens, and his factory is well equipped for carrying on work on a commercial scale and for accurate scientific experiments. With a view to bringing about a clear understanding as to the relationship of the Department to this work, a proper form of agreement has been prepared and entered into by the Department on the one hand and Dr. Shepard on the other. By the terms of this agreement the Department is able to secure the use of the extensive plant of Dr. Shepard for experimental purposes, and will profit by the results from the extensive work that he is carrying on. During the year careful attention has been given to methods of reducing the cost of the production of tea with very satisfactory results. Improved factory methods have also been put into operation, with the result that better grades of tea are now being turned out than ever before. To aid in this work, Dr. Shepard has secured during the year the assistance of an expert tea taster in New York, who has sampled his various grades and thus made it practicable to determine not only the kinds of teas which have proved of the highest quality, but the effects of different methods of picking and handling.

As pointed out in my last report, the yield of tea in Dr. Shepard's gardens last year was about 4,500 pounds, and this year there will be about 9,000 pounds of marketable tea. Some of the gardens have proved very prolific and profitable, while others have given very light yield of tea, having poor quality. All these facts, of course, will enable the Department to profit in further exploiting the work. With a view to increasing the interest in this crop, a tea farm will be established in Texas if suitable land and cooperation can be secured. Agents of the Department are now on the ground looking into the question, and the outlook is very favorable. Whether or not tea

growing in this country can be made a commercial success will depend, in large measure, upon most rigid attention to the details connected with the field and factory work. It is not expected that any large profits will be made, but it is believed that by proper and judicious management sufficient profit will result to encourage the planting of the crop in many parts of the South, especially where there is cheap labor available. Proper labor, of course, constitutes one of the most important factors in this matter; but, fortunately, there are many places in the South where hands now idle might be turned to some use in this direction.

Congressional Seed Distribution.

In my last report attention was called to the fact that the distribution of seeds was required by an act very specific in its terms, and that it was my wish to carry out the will of Congress in a way that would result in the most good to the country. During the year rapid advancement has been made in the matter of improving all of this work, and it is gratifying to announce that under the system which is being put into operation little or no friction has resulted. The Congressional distribution for 1901–2 was the largest in the history of the Department, yet notwithstanding this fact all the seed went out on time. With a view to increasing the value of the work, particular attention was given to the distribution of forage-crop seed, cotton seed, tobacco seed, and seed of other special crops. In each case an expert was put in charge of a particular crop and was responsible for securing new, rare, or little known varieties, and the distribution of each variety in a locality where it seemed likely that benefit would result from its use. Very encouraging reports have been received as a result of this work, especially in the matter of cotton distribution, where a special effort was put forth to secure new varieties or varieties which were known to have value locally, but which had not been generally distributed. With a view to still further increasing the efficiency of the seed work, a number of new plans have been put into operation during the year.

The method of securing seed through a contractor has been abandoned, as it was never satisfactory, offering opportunity for inferior service, and, besides, working a hardship on the seed trade of the country—something the Department has no desire to continue. Under the new system the Department secures its own seed in the open market, and contracts only for the purely mechanical features of the work, such as the packeting of the seed and the mailing of the same. With a view to making this work of more value to the country and encouraging the legitimate seed trade, plans have been inaugurated whereby the Department will gradually substitute new or little-known seeds, such as specialties or novelties, for the more common sorts here-

tofore distributed. Seedsmen are now cooperating with the Department in furnishing these specialties and novelties, and the Department will distribute them possibly only one year, dropping them then and allowing the demand, if demand there be, to be met by the regular trade. Particular attention will be given in all this work to the distribution of special crops, such as forage, tobacco, cotton, sugar beet, cereals, etc. In the handling of these special seeds and plants the work of the plant-breeding laboratories will be utilized, and the requirements of different sections of the country will receive careful consideration, so that crops will be selected to meet the needs and requirements of the districts into which they may be sent.

Foreign Seed and Plant Introduction.

During the year the Department pushed forward the lines of work on introduction of foreign seeds and plants as rapidly as the means at hand would permit. In carrying on this work the various branches of the Bureau have contributed to the expert knowledge to be applied to the best handling of the crops.

Agents have been sent to the Orient with a view to securing information on crops particularly adapted to the South. Rice has received special attention, and in addition the question of forage crops suitable for this region was also kept constantly in mind. An agent visited India, China, and Japan, and secured many valuable introductions in the way of seeds and plants which will be useful in building up new industries. This work has been greatly aided by the generosity of Hon. Barbour Lathrop, who, at his own expense, has carried on extensive agricultural explorations during the year, assisted by Mr. David G. Fairchild, an agricultural explorer of this Department. Mr. Lathrop has secured and forwarded to this country a number of valuable plants, which are being handled by the Department's agents and by private individuals, to whom such plants have been sent direct by Mr. Lathrop. Particular attention was given to the introduction of the bamboo, which it is believed will prove a promising crop in sections of the West and South, where this plant is hardy.

In former reports attention was called to the efforts of the Department in establishing date growing as an industry in this country. Considerable advance has been made in this direction during the past year, a large shipment of young date trees having been received from Mr. Lathrop. They were planted in the large cooperative date orchard established by the Department in Arizona. This orchard now comprises about 11 acres and contains 580 imported trees, besides 80 native seedlings. Another important introduction during the year through Mr. Lathrop's efforts is the Egyptian or berseem clover, which is very valuable for certain portions of the country as a soil reclaimer and enricher and as a forage plant. The continued fertility

of portions of the Nile Valley which are annually overflowed is largely due to the nitrogen-gathering properties of this plant.

Agents have also been sent to Algeria, Egypt, and other parts of Africa for the purpose of studying the irrigated crops of these regions, and also the crops which are particularly adapted to alkali soils. These agents have secured many valuable facts which will aid the Department in its extensive studies of the plants of our own arid and semiarid regions. With a view to securing additional forage crops and cereals from Russia and adjacent countries, an agent was sent to those regions in the early part of the year. The securing of forage crops, particularly the various kinds of Turkestan alfalfa, was the primary object of this visit; although some attention was given to obtaining varieties of fruits and cereals adapted to the dry regions of the Northwest.

MACARONI WHEAT.

The importance of the introduction and establishment of macaroni wheat in the United States, to which attention was directed in my last report, has been amply demonstrated by the results of the past year. We estimate that about 2,000,000 bushels have been harvested this season, but this will not meet the demand for it coming from all quarters. New mills are being built to grind it and old mills have been modified in order to handle it, and it now has its definite grade like other wheats in the Northwestern markets. It yields from one-third to one-half more than the other standard wheats in the same locality throughout the Great Plains region. Furthermore, it extends the wheat area much farther westward over districts of great extent, where it was not considered possible to grow wheat before, owing to light rainfall. The macaroni made from this wheat is pronounced by experts to be equal, if not superior, to the imported product, so that the success of this industry is assured.

WINTER WHEAT AND OTHER CROPS.

The results of the past year indicate that the winter wheats introduced and tested by the Department are likely to prove of as great, if not greater, value than the macaroni wheats. Four or five varieties obtained from east and south Russia are much more hardy than any varieties now grown in this country, and will extend the winter wheat area several hundred miles north and some distance farther west than at present. This means an increase of 5 to 10 bushels per acre over the standard spring wheats now grown in the same localities.

Quite valuable results have also been secured in the introduction of Swedish oats, proso or broom-corn millet, malakhof, sugar corn, and a number of other Russian crops. There has been rapid advancement during the year in the rice-growing industry, largely through the

efforts of the Department in the introduction of new forms and the obtaining of information from abroad bearing on the methods of handling the crop and preparing it for market. Particular improvement has been made in the rice-growing regions of Texas and Louisiana, where the work of the Department has yielded the most striking results. In former reports attention has been called to the great value of this work to the two States named, and such has been its development that at the present time the rice production in this country about equals the demand.

The Jordan almond is another successful introduction during the year. There are about 5,500,000 pounds of almonds grown in California, but many pounds are still imported from Spain for the reason that the California nut is not equal to the best imported kind, known as the Jordan. During the year buds and scions of this variety have been secured and sent to California, and it is certain that in a few years California-grown Jordan almonds will be on the market.

A special effort was put forth during the year to secure alkali-resistant crops, particularly alfalfas and cottons. Seed of the Turkestan alfalfa has been obtained and is now on the way to this country, and will be distributed, under proper direction, during the year. Seed, also, of a number of alkali-resistant cottons has been obtained in Algeria and Egypt, and steps are being taken to place these seeds where the conditions are such as to make their success a valuable adjunct to certain parts of our Western country.

As a means of further systematizing all of the work connected with the distribution of seeds and plants by the Department, and the introduction of the same from foreign countries, plans are being perfected for establishing in a number of places in the country testing gardens, which will enable the Department to work out a number of important problems connected with these investigations. It has been found by experience that the promiscuous dissemination of seeds, many of which are often of great value, does not give in all cases satisfactory results. It is highly important in all such cases to be able to determine definitely where such plants and seeds are likely to prove most successful. After this is known it is still necessary to convince farmers or fruit growers of the feasibility of growing the particular crop. Even then the work is not finished, for although the crop may be grown readily, the question of a market must be considered.

Suitable testing gardens, conducted possibly in cooperation with some of the experiment stations, but under the direct control of the Department, will be of great value in further continuation of this work. Such gardens may be used for the purpose of standardizing the various varieties of vegetables now being offered by the seedsmen throughout the country. There is at present a great deal of confusion regarding varieties of vegetables, and while the work of breeding is

growing apace it will be well worth while to fix the types of varieties and disseminate better strains of standard sorts. If the Department would set a high standard in this matter it would probably result in a great diminution of the indiscriminate renaming of varieties and in the introduction of such as are new only in some slight respect. It is obvious that work of this kind to be of the greatest value must be conducted under very careful conditions and be carried on in a sufficient number of regions to get results which will be of real value.

BUREAU OF FORESTRY.

On July 1, 1901, the Division of Forestry became a bureau. It has therefore completed its first year under the new form of organization. The results obtained have amply justified the change and the increased appropriation which accompanied it. Interest in forestry and a perception of its possibilities as the means of making productive a great national resource have developed so swiftly in the United States that the discrepancy between the capacity for public service of this branch of the Department of Agriculture and its opportunities was never so great as it is now.

During the past year the Bureau of Forestry has notably increased the store of knowledge on which all forestry depends, and has made large gains in introducing practical management of forests, both of public and private ownership. Its field work has engaged 162 men, and has been carried on in 42 States and Territories.

The forest work of the Department of Agriculture has hitherto proceeded as rapidly as the scanty means of forest education would supply men, and its growth has been normal and safe. In view of the greater product of the forest schools and the immensely growing demand upon its services it might hereafter safely increase its rate of progress. To check the growth of the Bureau of Forestry at this time will likewise check the spread of public sentiment in favor of forest protection. It will dull the desire of forest owners, applicants to the Bureau for assistance, some of whom have already waited for their turn until their patience is almost exhausted. It will dampen the willingness of young men of the right stamp to make forestry their profession, because they look forward with practical unanimity to the Government service. A single frost which would pass over a mature tree without effect will often injure and retard for years the growth of a healthy seedling. I conceive the Bureau of Forestry to be in precisely that situation.

Organization of the Bureau.

The work of the Bureau of Forestry is organized along four lines: Forest management, forest investigation, records, and tree planting.

Forest Management.

The Bureau of Forestry exists to secure the best management of the forests of the United States in the interests of the whole people. This involves not only the development of a science of American forestry, but also the general introduction of conservative methods in handling forests of private ownership.

The Division of Forestry offered in October, 1898, to give advice and assistance to forest owners desirous of introducing conservative management. The response to this offer was immediate, and has grown steadily in volume. During the last fiscal year 37 applications were received, asking advice for the management of nearly 2,000,000 acres of forest lands. Altogether the advice of the Bureau has been asked, since its offer in October, 1898, on 4,709,124 acres.

The working plans of the past year are in the nature of solutions of seven typical and widely differing forest problems. These problems are:

Management of a Southern Appalachian forest, containing a great variety of trees, mainly hardwoods, in a somewhat inaccessible region, where only the most valuable species can be lumbered at a profit and where special measures are necessary to assist their reproduction and to prevent the progressive deterioration of the forest as the best woods are cut out. Fire protection, at a cost which is not prohibitive from a business standpoint, forms one of the important questions involved. The tract studied has an area of 110,000 acres, and lies in Polk and Monroe counties, Tenn.

Management, in conjunction with coal mining, of a tract of mixed softwoods and hardwoods, containing 50,000 acres, in Scott, Campbell, and Anderson counties, Tenn. Silviculture, contract lumbering, transportation, and protection from fire are the more important points studied.

Management of 60,000 acres in Beaufort and Hampton counties, S. C., on which the most important commercial species is Longleaf Pine. Fire, lumbering, and turpentine orcharding have seriously injured the forest, and the consideration of first importance is a method of treatment which shall restore it to full productiveness while yielding a fair return on the value of the land. The conditions are typical of much of the Southern Pine Belt.

Management of 10,000 acres of fine hardwoods on Grand Island, Michigan, with an accessible market, a high price obtainable for the product, and consequently an exceptionally good opportunity for paying forestry.

Management of 15,000 acres in Herkimer County, N. Y., composed equally of cut-over and virgin forest. The most important timber tree is here, as generally in the Adirondack region, Red Spruce,

and the chief object of the working plan was to provide for the reproduction of this species and to suggest such changes in present methods of lumbering as will give immediate and good returns from the forest and at the same time will insure a profitable future yield.

A somewhat similar problem, but in a different locality, was that presented by a tract of 275,000 acres in northwestern Maine. Field work was completed during the year on 150,000 acres of this tract, timbered mainly with Red Spruce and Balsam, of which the former, as commercially the more valuable of the two, should be favored as the source of subsequent crops.

The last tract on which field work was completed during the year was one of 15,000 acres near Arden, N. Y. The forest consists of second-growth hardwood and is for the most part in poor condition. The working plan advises a system of thinnings by which the condition of the forest will be improved and which will at the same time yield good returns in firewood.

The total forest area now under management in accordance with working plans prepared by the Bureau of Forestry is 372,463 acres. Material for a number of new working plans is now being gathered. Especially notable is the plan in preparation for a tract in southeastern Texas which comprises an area of 1,250,000 acres and is the largest private holding of timber land in the United States.

By request of the Secretary of the Interior for advice in the management of the national forest reserves, which now include 60,162,525 acres, the Bureau of Forestry became the official adviser for these reserves in matters of forest policy. The making of working plans for the reserves has continued during the year. Field studies have been carried on in the Prescott, the Priest River, and the Big Horn reserves, and a preliminary examination was made of the San Francisco Mountains Reserve. A similar request from the Secretary of War, made during the last fiscal year, has placed the Bureau in the same relation toward the military wood and timber reservations, eight in number, with an area of 117,468 acres. Of these, that at West Point, containing 2,000 acres, has been examined, and a working plan for its management will soon be prepared.

In accordance with the request of the Secretary of the Interior, an examination has been made of the forest lands within the Lac Court d'Oreilles, the Bad River, and the Menominee Indian reservations, in Wisconsin, in order to recommend measures for the conservative lumbering of the timber they contain.

Forest Investigation.

The studies of commercial trees made during the past year include White Pine, Red Pine, White Oak, Scarlet Oak, Red Oak, and Aspen,

in Michigan; Sugar Pine in California; Balsam in Maine; White Oak and Chestnut Oak in Tennessee, Kentucky, and Missouri; Western Yellow Pine in Arizona, and Lodgepole Pine in Wyoming and Montana. Previous studies of the Longleaf and Loblolly pines, of the Sierra Big Tree of California, and of the Bristle-cone Fir in southern California were completed and reports prepared on Western Hemlock and the Pacific Coast Redwood.

Studies of the growth and possibilities of New England second-growth hardwoods were carried on, and an investigation was begun of the distribution and the conditions necessary to the best development of the trees comprising the eastern Missouri and Arkansas swamp forests.

Studies of the forest and its industrial relations were made in the States of Michigan, Kentucky, Ohio, Texas, New Mexico, Arizona, South Dakota, Wyoming, Montana, California, and Iowa. Some of the questions involved were the present and future timber supply, forest fires, and the relation of the forest to stream flow, irrigation, and grazing.

Descriptive studies were conducted in cooperation with the United States Geological Survey of about 3,000,000 acres of the Sierra Forest Reserve and of the region in the Southern Appalachians, within which it is proposed to establish a national forest reserve.

In cooperation with the Bureau of Chemistry, investigations have been undertaken of native tan extracts and their comparative values in tanning, of Philippine gum products, and of possible additions to the present list of native woods suitable for the production of paper pulp.

A cooperative study of insects which injure the forest was begun with the Division of Entomology.

It is highly gratifying that the efforts which the Bureau has been making to discover a less injurious method of turpentine orcharding than that hitherto employed, and to which I made reference in my last report, have been successful, and that the way is apparently open for the general introduction of an improved method which will be of notable value in maintaining the source of the turpentine industry.

Tests of the durability of treated and untreated construction timber and railroad ties have been continued, in cooperation with the Bureau of Plant Industry. The enthusiastic assistance which has been received from railroad companies has demonstrated their appreciation of this valuable work.

In cooperation with the Bureau of Chemistry, and as the result of a widespread and urgent demand, the Bureau of Forestry has taken up the series of tests to determine the strength of the principal merchantable timbers of the United States, which were discontinued in 1896.

Records.

The enlargement of the Bureau's quarters, which took place during the year, made possible for the first time the proper equipment of a library and the transference thither of the entire collection of forest literature from the Department library. This has given the Bureau a large, easily accessible working and reference library. The photographic collection now numbers over 6,000 prints, and a well-equipped photographic laboratory has been installed.

Tree Planting.

The work of the Bureau in tree planting for the last year has been chiefly notable in the conspicuous progress made in extending cooperative planting, in the creation of the first reserves for forest planting on Government lands in a region that is now unproductive of timber, and in the successful initiation of measures to control, by means of planted forests, the shifting sand dunes on both the Atlantic and the Pacific coasts.

In tree planting as in forest management the Bureau has sought, as the only method by which the desired end could be attained on a broad scale, to enlist the interest of the private landowner. Circular No. 22, issued July 8, 1899, offers cooperation in the work of planting forests similar to that previously made for forest management. Up to the close of the last fiscal year 262 applications for assistance had been received, nearly 200,000 acres had been examined, and 224 planting plans, covering about 6,400 acres, had been made. Of these, 51 plans for about 3,400 acres were made during the past fiscal year, and 83,597 acres were examined.

These figures, however, by no means cover the actual accomplishment of the Bureau in introducing forest plantations on private lands. The plans made are for 172 localities, in 29 States and Territories. Not only does the example set by each plantation made affect the whole neighborhood, but there has also been in many cases a public agitation of the question of tree planting, with local meetings addressed by the agents of the Bureau. Extensive planting on other land than that for which plans were made has frequently followed. Plantations of this kind will be of very considerable economic value in many States of the Middle West by furnishing local supplies of firewood, fencing, telegraph poles, and railroad ties, besides providing wind-breaks and other protection.

The success of economic tree planting in many scantily timbered or treeless regions of the Middle West is now assured. This means enhanced prosperity for these regions. A local timber supply is a matter of decided importance to the farmer, who needs cheap fuel and fencing. As a result of the Bureau's work, thriving plantations now

exist in the Dakotas, Nebraska, Kansas, and Oklahoma, as well as in the older States of Iowa, Illinois, and Indiana.

In New England particular attention has been given to the possibility of profitably planting cheap land with white pine. The supply of this highly useful timber tree has been greatly diminished in the Eastern States. If it can be brought back as a paying forest tree under management, the benefit will be one in which both the landowner and the timber-consuming public will share. So encouraging has been the outcome of the examination of this question by the Bureau that many owners of denuded lands are restocking them with white pine.

The Proposed Appalachian Forest Reserve.

In my report on the Forests and Forest Conditions of the Southern Appalachian Mountain region, which has been printed along with your message to Congress on this subject, of December 19, 1901, I discussed briefly the rapid rate at which the forests on these mountain slopes were being removed, and the extent to which the resulting floods were destroying agricultural lands and other property along the streams rising in that region. In that report I stated that the damages resulting from these floods during the year (1901) "approximated $10,000,000, a sum sufficient to purchase the entire area recommended for the proposed reserve."

Subsequent examinations have shown that during the few months following the date of that report the flood damages on these streams, extending across eight different States, aggregated $8,000,000, making a total of $18,000,000 during the twelve months ending in April, 1902. These examinations also show, as additional results of the deforestation of these mountain slopes, (1) that the water powers along these streams, which have an aggregate annual value of $20,000,000 as a basis for manufacturing enterprises, are being gradually but certainly destroyed through the increasing irregularity in the flow of the streams; (2) that the soils which are being washed down from these mountain slopes are rendering annually less navigable the Ohio, the Tennessee, the Mississippi, and other rivers of these Southeastern States; and (3) that the rate of land erosion on these mountain slopes from which the forest cover has been removed is now as great in a single year as it was during ten centuries while these slopes were covered with primeval forests.

A bill providing for the establishment of the forest reserve recommended in my report is now pending before Congress. With an increased realization of the importance of this measure I reproduce here the concluding paragraph of that report:

> The preservation of the forests, of the streams, and of the agricultural interests here described can be successfully accomplished only by the purchase and creation of a national forest reserve. The States of the southern Appalachian region own little or no land, and their revenues are inadequate to carry out this plan. Federal action is obviously necessary, is fully justified by reasons of public necessity, and may be expected to have most fortunate results.

BUREAU OF SOILS.

The organization and work of the Bureau of Soils has been essentially along the same lines as heretofore, with the addition of an important line of work in the division of soil management. Attention has been given, as heretofore, to the administrative work, the soil survey, the tobacco investigations, drainage investigations, and the laboratories maintained in support of these several lines of field work. The wisdom of Congressional action in converting the Division into a Bureau and increasing the appropriation has been shown in the amount of work done and in the appreciation of this work from various sources. The soil survey, particularly, has been greatly extended, and the division of soil management, although merely started during the year, gives promise of some more important results than have been achieved in soil investigations for some time past. Prof. Franklin H. King, formerly professor of agricultural physics at the University of Wisconsin, has taken charge of this line of field work. He is considered peculiarly fitted for this place, and his appointment has been very generally commended.

During the year Mr. M. L. Floyd, the tobacco expert who had done so much to make successful the tobacco investigations of the Bureau, severed his connection with the Department to become general manager of a tobacco corporation organized to grow the shaded Sumatra tobacco in Connecticut, an industry established by this Department. In his new position Mr. Floyd receives far greater remuneration for his services than the Department could afford to pay, in view of the salaries paid to others by the Government.

The interest in the work of the Bureau of Soils is growing, and the demands for work in different parts of the country are increasing, as evidenced by the liberality of Congress in enlarging the appropriation and by the many requests received for the extension of the different lines of investigations. The Bureau of Soils now has a force of over 100 persons, 75 of whom have had a scientific training. It is believed that the results of the work in showing the conditions and resources of the soils of the country and in giving the people precise and accurate knowledge regarding the possibilities of the soils justifies fully every expenditure that has been made and every recommendation that will be made for the further extension of the work. With the fierce competition for commercial supremacy now operating, every particle of information bearing upon the natural resources of the country which will in any way tend to increase the production of our present crops or to develop new methods or build up new industries is of the utmost value, especially if, as in this case, the people are inspired with sufficient confidence to heed the advice of the Department and to take advantage of its work.

Cooperation with State Institutions.

During the year this Bureau has cooperated, as far as possible, with State institutions, including experiment stations, boards of agriculture, and geological surveys; also with Bureaus and Divisions of this Department, as well as with other Departments of the Government. Such cooperation has been particularly close with the North Carolina department of agriculture and with the Illinois experiment station, both of which institutions have contributed money toward the expenses of the soil survey in their respective States. In other States the cooperation has been just as cordial, but the institutions have not been able to render financial assistance. Their advice has been sought and given wherever possible in arranging for and in the carrying on of the work, and the work has been done, as far as possible, with the ultimate object of being of service to the State institutions in the prosecution of more detailed work. The Utah experiment station has cooperated in the line of drainage investigations and has contributed valuable assistance and advice in the work that has been started at Salt Lake City. The Connecticut experiment station and the Pennsylvania experiment station have continued their cooperation in the tobacco investigations with credit and profit to all of the institutions concerned.

The Bureau of Soils, through its laboratories, its soil survey, and its other lines of investigation, has cooperated with and has helped other Bureaus and Divisions in the Department, and has cooperated with the War Department in furnishing an assistant to organize a soil survey in the Philippine Islands, and in furnishing assistants to inspect the soils of some of the military posts and to advise as to the treatment in the establishment of parade grounds, a matter which is of considerable importance, involving the expenditure of large sums of money where the natural soils are not suited to the formation of a permanent sod.

Progress and Cost of the Soil Survey.

The area surveyed and mapped during the fiscal year was 14,541 square miles, or 9,306,240 acres, and the area previously reported as having been surveyed was 8,082 square miles, making a total of 22,623 square miles, or 14,478,720 acres. This work was carried on during the year in twenty-five States and Territories and in Porto Rico.

The following table shows the total area surveyed during the fiscal year 1902, together with that previously reported, in each of the thirty States and Territories in which the soil survey work has been carried on. This work has been uniformly done on a scale of 1 inch to the mile, and the maps have been published or are ready for publication. This table does not include any areas in which work of reconnoissance merely has been done, but only areas in which actual soil surveys have been made and soil maps prepared.

Areas surveyed and mapped during fiscal year ended June 30, 1902, and the areas previously reported.

State or Territory.	Work during 1902.	Work previously reported.	Total.	
	Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Acres.*
Arizona	95	400	495	316,800
California	753	1,401	2,154	1,378,560
Colorado	150	.....	150	96,000
Connecticut	.....	245	245	156,800
Georgia	571	.....	571	365,440
Idaho	399	.....	399	255,360
Illinois	1,359	.....	1,359	869,760
Iowa	432	.....	432	276,480
Kansas	461	.....	461	295,040
Kentucky	330	.....	330	211,200
Louisiana	202	.....	202	129,280
Maryland	418	1,762	2,180	1,395,200
Massachusetts	.....	155	155	99,200
Michigan	828	.....	828	529,920
Mississippi	666	.....	666	426,240
Missouri	168	.....	168	107,520
Montana	105	.....	105	67,200
New Jersey	908	.....	908	581,120
New Mexico	.....	100	100	64,000
New York	490	.....	490	313,600
North Carolina	1,625	1,800	3,425	2,192,000
Ohio	500	480	980	627,200
Pennsylvania	519	420	939	600,960
Porto Rico	330	.....	330	211,200
South Carolina	686	.....	686	439,040
Tennessee	547	.....	547	350,080
Texas	495	.....	495	316,800
Utah	.....	768	768	491,520
Virginia	1,354	250	1,604	1,026,560
Washington	150	301	451	288,640
Total	14,541	8,082	22,623	14,478,720

The following table shows the area surveyed and mapped and the cost of the work during the fiscal year ended June 30, 1902:

Areas surveyed and mapped and cost of the field work during fiscal year ended June 30, 1902.[a]

State or Territory.	District.	Area surveyed.	Cost per square mile.	Total cost.
		Sq. miles.	*Dollars.*	*Dollars.*
Arizona	Yuma area	95	4.61	437.95
California	Imperial area	169	3.17	535.73
Do	Salinas Valley	344	3.42	1,176.48
Do	Ventura area	240	3.77	904.80
Colorado	Rockyford area	150	4.73	709.50
Georgia	Cobb County	346	1.44	498.24
Do	Covington area	225	.71	159.75

[a] This includes the salaries of the men while in the area and their subsistence expenses, but not the cost of transportation to and from the area.

Areas surveyed and mapped and cost of the field work during fiscal year ended June 30, 1902—Continued.

State or Territory.	District.	Area surveyed.	Cost per square mile.	Total cost.
		Sq. miles.	*Dollars.*	*Dollars.*
Idaho	Boise area	399	1.81	722.19
Illinois	Clinton County	494	.88	[a] 434.72
Do	St. Clair County	215	1.15	[a] 247.25
Do	Tazewell County	650	1.39	[a] 903.50
Iowa	Dubuque area	432	.94	406.08
Kansas	Wichita area	461	1.94	894.34
Kentucky	Union County	330	2.20	726.00
Louisiana	Lake Charles area	202	3.71	749.42
Maryland	Harford County	418	1.48	618.64
Michigan	Allegan County	828	1.44	1,192.32
Mississippi	Yazoo area	656	2.24	1,489.96
Missouri	Howell County	168	1.14	191.52
Montana	Billings area	105	4.96	520.80
New Jersey	Salem area	493	1.42	700.06
Do	Trenton area	415	2.23	925.45
New York	Westfield area	260	2.89	751.40
Do	Elmira area	230	2.03	466.90
North Carolina	Alamance County	365	1.32	[b] 482.80
Do	Carey area	63	3.11	[b] 195.93
Do	Craven area	697	.96	[b] 669.12
Do	Hickory area	500	1.01	[b] 505.00
Ohio	Columbus area	338	1.34	452.92
Do	Toledo area	162	.95	153.90
Pennsylvania	Lebanon area	[c] 519	1.48	768.12
Porto Rico	Arecibo to Ponce	330	5.02	[d] 1,655.55
South Carolina	Abbeville area	686	1.01	692.86
Tennessee	Montgomery County	547	1.68	918.96
Texas	Alvin area	280	2.45	686.00
Do	Willis area	215	2.70	580.50
Virginia	Bedford area	[c] 382	2.11	806.02
Do	Harrisonburg area	542	1.44	780.48
Do	Prince Edward area	430	1.32	567.60
Washington	Walla Walla area	150	1.82	273.00
		14,541	1.83	26,551.76

[a] Of these amounts, $624.95 was spent by the Illinois experiment station.
[b] Of these amounts, $914.20 was paid by North Carolina department of agriculture.
[c] The portions of these areas surveyed in the previous fiscal year were given in the last report.
[d] Of this amount, $300 was paid by the Porto Rico experiment station.

RECAPITULATION.

Cost of field work	$26,551.76
Supplies	858.84
Railroad transportation	2,766.28
Preparation of reports	12,870.17
Total cost of soil survey	43,047.05
Paid by State organizations	1,839.15
Paid by Department of Agriculture	41,207.90
Area surveyed ..... square miles	14,541
Cost of work in field ..... per square mile	$1.83
Preparation of reports ..... do	.88
Transportation and supplies ..... do	.25
Average cost ..... do	2.96
Average cost to Department of Agriculture ..... do	2.81

It will be noticed that the cost of the work per square mile varies from 71 cents in the Covington area, Georgia, to $5.02 for the work in Porto Rico. The average cost has been $1.83 per square mile, as against $2 per square mile during the preceding fiscal year. The area covered is over two and one-half times as large, and the work has cost 17 cents per square mile less than last year. The variation in the cost per square mile is due in part to the character of the country, the condition of the roads and of the weather, the complexity of the soils, the presence and character of alkali in the Western areas, and the accuracy of the base maps used. The average cost to the Department of Agriculture of the work complete, including supplies and railroad transportation, the preparation of reports, and the salaries of the men during the three winter months, when the field work has practically to be suspended, has been $2.81 per square mile, as against $3.26 per square mile last year, a saving of 45 cents per square mile. This saving is due not only to the greater efficiency of the field parties by reason of their better training, but also to the longer average length of the field season for each party, which has been accomplished by moving the parties from place to place as the season advances. It has been found possible to keep some of the parties out during the winter in Arizona and southern California, and to shift parties working in the Northern States during the summer months to the Southern States during the fall. In this way the average length of the field season has been something over nine months per party, and it is believed that this can be considerably increased, although it is advisable to have each party spend some time at headquarters, not only for the final revision of their reports and maps, but to get acquainted with the office and laboratory work and to keep in close touch with the objects and purpose of the soil survey.

THE FIELD FORCE.

The organization of the field force has been carried to a very high state of efficiency. Administratively the very greatest of care and attention to details is given, and the low cost per square mile shown in the preceding statements is due in a large measure to the judicious and economical management of the force. The salaries of the soil experts employed by the Bureau are low as compared with those paid in other branches of scientific work. The average expense of a party of two men in the field for subsistence and the hire of a team averages about $120 per month, or $1,080 for the field season of nine months. The parties are equipped with the most modern instruments for the classification and survey of soils, and it has been possible to furnish them with such explicit instructions as to the character of their work, the subjects they are to investigate, and the subjects which are to be discussed in their report upon the area that they know exactly

what is to be done on entering a given area and can proceed with their work with the minimum of time for preliminary investigations or reconnoissances. They are required to report to the central office at least once each week, noting the area surveyed, the new soil types established, and the character of their work, and to send in from time to time sections of their map for criticism and suggestion as the work proceeds. It is required that each party shall complete the map in all details and write up the report in final shape before leaving the area. These reports are then typewritten, and a copy returned to the field party for correction or for additions or changes. The work of each party is thoroughly inspected, so far as this has been possible, in order to correlate the new soil types with those already established, and to confer with the men as to suggestions which can be safely made of new methods of cultivation or of new industries which may be established. As the work of the soil survey assumes greater proportions this inspection work becomes more and more necessary and more valuable, and it is advisable that a regular inspection force should be established for the several districts into which the country may be divided.

The scale upon which the soil maps are published enables tracts as small as 10 acres to be represented, and while there must always be some variation allowed in each type, as it would be confusing to show too much detail on the maps, still, where a type is represented by even a small tract of 8 or 10 acres, it is shown upon the soil map, so that landowners may rely upon an accurate classification of their soils according to the types established.

The reports describe in all necessary detail the characteristics of the soils and their important variations; the history of the settlement and agricultural development of the area; the climate, physiography, and geology; the agricultural methods in use and the agricultural conditions in the area, such as the tenure and size of the farms, the efficiency of labor, the principal products, and transportation and market facilities, together with such special problems as may be encountered, such as hardpan, acidity, irrigation, seepage waters and drainage, alkali, and the reclamation of swamp or worn-out lands or alkali soils, as these all have their bearing upon the commercial use and value of the soils.

RELATION OF THE SOIL SURVEY WORK TO THE EXPERIMENT STATIONS.

With the increasing interest in the soil investigations and the economic value which the results have shown in a number of cases, the experiment stations are taking a lively interest in this work, and it seems proper to mention the true relation which should be established between them and the Department in the further prosecution of the work. It seems advisable that the management of the soil survey

should be vested in the Department of Agriculture. This insures continuity in the work and uniform classification of soils; also the benefit of experience in other localities in advising as to the commercial possibilities and value of the introduction of new methods of culture and of new crops and industries. It is advisable that the experiment stations and other State institutions should cooperate in this work to the extent of furnishing assistants or financial aid, as this insures an intimate knowledge of the conditions of the area to the State organization, as well as a larger amount of work within the borders of the State. In many cases, if such financial assistance be given, one or more parties can be assigned for continuous work in a State where, if the expenses were all borne by the Bureau of Soils, a party could be assigned for only a portion of the season. Various State organizations have contributed $1,839.15 toward the field expenses of the soil survey during the past year.

These soil surveys are in the nature of a general reconnoissance of the area. They show the conditions which prevail, and the maps show the character and distribution of the soils. This is, however, merely a basis for further work, and it is necessary in many cases that the information thus furnished and the suggestions which are made should be followed by further investigations and practical demonstrations of the efficiency and commercial value of the suggestions in order to insure their successful adoption by the residents of the area. Farmers are proverbially ultraconservative as to their methods, and are usually, and often justifiably, very unwilling to accept advice unless it can be shown that improvement will surely follow. Such demonstration work can, in most cases, be better accomplished by the stations than by the Department of Agriculture, for the station forces have a more intimate knowledge of the conditions and of the people, and are, as a rule, in closer touch with the people than is the Department, and with these reports and maps they have the basis for further work in the improvement of the agricultural conditions of the area, upon which they can expend their full energy and all the resources at their command. If the soil-survey work is not followed up on these practical lines, much of the efficiency and value of the work will surely be lost.

As pointed out in my last report, the experience of the men engaged in this work is likely to be invaluable, not only to them, but to the country as well. Spending, as they do, from three to nine months in an area, making a critical study of the soils, crops, methods of cultivation, and market and transportation facilities, and bringing together this experience from all sections, the men have unusual opportunities for securing a wide knowledge of the agricultural industry of the country and its resources. This is training up a class of men fitted to observe and appreciate resources and advantages that should be of

great value in the further development of the agricultural interests of the United States as the country becomes more thickly settled and the strife for commercial supremacy becomes greater. As these men become riper in experience and judgment and have a fuller knowledge of the agriculture of the country, they will doubtless be called to positions of trust and responsibility in State organizations and in commercial enterprises in which their experience and ability will be invaluable. This is and should be one of the important functions of the Department, and the influence of the Department will be felt more and more throughout the country as these men are called to such positions.

PAST AND PROPOSED WORK OF THE BUREAU OF SOILS.

The statements following show the results that have been accomplished during the past year and the work that is proposed during the present and the next fiscal year in each of the States. This is of course subject to change as to details as the time approaches for the actual prosecution of the work. It is given as the basis for the continuation and extension of the work.

ALABAMA.

No work has been done in this State during the past fiscal year, but it is proposed this fall to make a soil survey of Perry County, which lies partly in the black calcareous prairie belt and partly in the sand region. Two parties will be assigned to this area in October, with the expectation that the whole of the county can be surveyed during the present field season. On the completion of this work both parties will be transferred to Mobile County to make a soil survey of that area, particularly in the interest of the truck growers, and to investigate the adaptation of the soils to tobacco. After this it is contemplated to make a soil survey in Marshall County in the interest of the fruit and tobacco growers, and to survey Lauderdale County, if possible. In all, it would be advisable to spend nine months in Alabama during the next field season.

ARIZONA.

During the past field season a soil survey was made of the area below Yuma, where the waters of the Colorado River are taken out for irrigation. The whole area covers about 95 square miles, although only a portion of it is at present under ditch. A considerable part of this area is subject to overflow during flood times in the Colorado River, and schemes have been proposed for dikes and levees to prevent this overflow, which, if carried out, will add a considerable area of valuable land to the irrigated district. This tract, with its tropical climate and fertile soils, has been compared to the delta of the Nile, and it is the

intention of the Department, through its soil survey and through the work of the Bureau of Plant Industry, to see if crops equally as valuable as those cultivated along the Nile and adapted to this tropical climate can not be introduced.

This party was in charge of Mr. J. Garnett Holmes, who has had considerable experience in soil survey work in other parts of Arizona and in southern California.

It is believed that the information obtained in this work will be the basis of most valuable economic development in the introduction of crops from Algeria and Egypt. There is quite a variety of soils of different character in this area, and while there is considerable trouble with alkali it is believed that this problem can be easily controlled and that the locality will develop into one of the important irrigated districts of the West.

It seems advisable to spend three months in a soil survey of the upper Gila Valley around Solomonville during the next field season.

ARKANSAS.

No soil surveys have been made in this State during the past fiscal year, but a party is at present in the State, making a survey around Stuttgart. It is impossible at this time to make any statement as to the economic results of this work.

CALIFORNIA.

Soil surveys have been carried on in three areas during the fiscal year, namely, around Imperial in the Colorado Desert, in the Salinas Valley, and in the Ventura area.

The work in the Salinas Valley was undertaken particularly in the interest of the sugar-beet growers. This was formerly a great wheat area, but in recent years the yield of wheat has fallen almost below the point of profitable production and barley has taken its place to a considerable extent. The rainfall, however, is so variable that crops are uncertain without irrigation, and irrigation systems are now being planned, particularly for the sugar-beet industry, which has developed to large proportions.

This party was in charge of Mr. Macy H. Lapham, and the area surveyed covered 344 square miles. Eleven different types of soils were recognized and their relation to the various crops determined. The relation of these soils to crops had been recognized to a certain extent, but the orderly classification of the soils can not fail to be of value in the future development of the agriculture of the area, especially as the industry is at present changing and developing along new lines.

All of the soils capable of cultivation in Ventura County were surveyed by a party under the charge of Mr. Holmes, the area aggregating 240 square miles. There are several valleys where irrigation is

practiced, the most extensive being the valley of the Santa Clara River. Over a large part of the area, however, crops are grown without irrigation, the principal crops being lima beans, sugar beets, and barley.

The soils of the upper part of the Santa Clara Valley are generally well drained and free from alkali. Extensive areas of the delta lands, including some of the most fertile soils of the county, are deficient in drainage, and the alkali problem is becoming more and more serious. As a result of the survey, and from experiments that have been made at the suggestion of the Bureau, it is evident that the alkali problem can be economically and efficiently controlled. Thirteen types of soils were recognized in this area and their relation to crops reported upon.

From the results attained in the irrigation of the area below Yuma, and from the exceedingly arid climate, it was believed that the Colorado Desert afforded exceptional facilities for the introduction of certain tropical plants, as well as for Egyptian cotton and other products successfully grown in Egypt and on the Algerian Desert. In furtherance of this idea, a company was organized under the laws of Mexico to construct a canal through Mexican territory and deliver water from the Colorado River to a point near Calexico, on the border line between this country and Mexico, to a company chartered under the laws of the United States to distribute the water to settlers in the Colorado Desert. The land was taken up under the homestead and desert-land laws and water rights purchased from this company for the irrigation of the lands. It was realized that it was very desirable, as this enterprise was starting, to make a soil survey in order to classify the soils and determine their alkali content and their relation to crops. Accordingly, Messrs. Means and Holmes were assigned to this work, and an area of 169 square miles was surveyed around Calexico and Imperial.

This country lies at or somewhat below sea level, the Salton Sink, the lowest portion of the desert, being about 270 feet below sea level. Five distinct types of soil were recognized in this area, ranging from a loose, incoherent dunesand to a very impervious clay, and including a sand, a sandy loam, and a loam. The area is everywhere underlain with a stiff, impervious clay containing alkali. The Imperial clay is difficult to cultivate, and water penetrates it very slowly. Large areas of alkali lands were encountered, and it is estimated that about 54 per cent of the area has more than 0.4 per cent alkali as an average for 6 feet in depth. There are serious problems, therefore, to be encountered in the successful development of agriculture in the area. It is believed that about 50 per cent of the area can at present be cultivated in nearly all crops adapted to the locality, while a considerable portion of the remainder may be reclaimed by drainage, or can be used for alkali-resistant crops.

The importance and necessity of having this knowledge of the soil conditions has been recognized, and very urgent requests have been received for an extension of the soil-survey work to embrace practically all of the lands in the Colorado Desert which can be irrigated, as a basis for the intelligent cultivation of this area, and to insure, as far as possible, the successful settlement of the country. Recognizing the importance of this work, it is proposed to combine a number of our field parties and place them in the area during the coming fall and winter to make a soil survey of about 1,500 square miles of the Colorado Desert, so that settlers may know the actual character of the soils which they purchase, and that industries can be established on the soils best adapted to them.

In addition to this work it is proposed to extend the soil survey to the Santa Clara Valley in the interest of sugar-beet, grain, and stock production, and to take up the San Bernardino Valley in southern California, which is the last of the great fruit areas in southern California that remains to be surveyed. It is believed that very valuable results will be attained by the soil survey when it is extended to the sugar-beet area around Chino and the fruit areas of Pomona, Riverside, San Bernardino, and neighboring towns.

In all it appears desirable to spend twenty-one months, on the basis of one party, in the State of California during the next field season, and it is believed that the importance of the areas to be investigated fully justifies the time and attention to be given to the work.

COLORADO.

During the present field season a soil survey is being made, under the charge of Mr. Macy H. Lapham, of the irrigable lands of the Arkansas Valley between Rockyford and the Kansas State line. There will be nearly 1,000 square miles of intricate soil mapping, with alkali problems to be worked out, but it is believed that by concentrating some of the northern parties in this area during the fall the whole area can be surveyed. This work is undertaken principally in the interest of the sugar-beet growers and of the melon and truck growers. Not only is it desirable to understand better the relation of the soils to crops, but with the extension of irrigation systems the natural drainage is found to be deficient and alkali is rising and threatening trouble and losses. The work has progressed far enough to indicate that the alkali problem can be economically and efficiently controlled, and it is believed that the classification of the soils will give a basis for the most profitable development of the sugar-beet and truck interests of the area.

It appears desirable to spend about six months during the next field season in a survey of the San Luis Valley, where the alkali problem is becoming far more serious even than in the Arkansas Valley.

CONNECTICUT.

No extension of the soil survey has been made in the Connecticut Valley since 1899, but with the extension of the profitable industry of producing the shade-grown Sumatra tobacco there is a very strong demand now that the survey should be extended to include many smaller valleys on either side of the area surveyed in 1899, and it is proposed to spend about three months in the State during the next field season, to give a basis for the extension of the tobacco industry on either side of the main valley.

DELAWARE.

No surveys have been made as yet in Delaware, and none is contemplated during the present year. There is, however, a demand for a soil survey to extend over the entire State, and it seems desirable to spend three months in the State during the next fiscal year in such work.

FLORIDA.

No surveys have been made in this State up to the present time, but it is proposed, if suitable arrangements can be made for a base map, to make a soil survey in Gadsden County in the interest of the tobacco growers.

GEORGIA.

During the past fiscal year two areas were surveyed in Georgia, including Cobb County and an area around Covington, the former being under the charge of Mr. R. T. Avon Burke and the latter of Mr. Herbert W. Marean.

It was hoped that the survey in Cobb County would show the possibilities of fruit raising, but it is believed that the prospects for this industry are not so favorable in this locality as they are farther north, and it is therefore proposed to extend the survey to include the northern half of the Ellijay sheet of the United States Geological Survey to include portions of Union, Gilmer, and Fannin counties in the interest of the fruit growers and as an extension of the survey in the mountain areas in Virginia and North Carolina. It is intended to give about six months to this work during the next field season, and it is also proposed to survey an area in Decatur County in the interest of the tobacco growers.

HAWAII.

No soil survey has been made in this Territory as yet, but there have been strong demands for the work, and a recommendation will be made for needed legislation to permit the Department to extend its soil survey work to that Territory at an early date.

IDAHO.

A soil survey party, under the direction of Mr. C. A. Jensen, has completed a survey of the Boise area, extending from Boise City to a point some distance west of Caldwell and including the principal irrigated lands of that section. Serious problems were encountered in this area in the occurrence of hardpan in the soils, and there were other soil problems upon which advice was given which it is believed will be of material economic value in the agricultural development of the area, which is assuming considerable importance.

A party, in charge of Mr. Louis Mesmer, has been assigned to survey the area between Lewiston and Moscow. The wheat yields in this area have declined, and the people are anxious to introduce forage crops, and the soil survey work is to be used as a basis for the consideration of this problem.

Representations have been made to the Department which make it appear advisable to spend about six months in the next field season in the survey of the irrigated lands of the Blackfoot area.

ILLINOIS.

Through cooperation with the Illinois experiment station the Bureau was enabled to put two parties in the field during the early part of the present field season, and at the close of the fiscal year had made a soil survey of Tazewell and Clinton counties, under the direction of Mr. Jay A. Bonsteel, and a portion of St. Clair County, under the direction of Mr. George N. Coffey. During the remainder of the present field season it is proposed to finish St. Clair and Clay counties, if time permits. So far as this work has been examined, particularly the finished maps of Tazewell and Clinton counties, it is believed that the results will be of material benefit and value to the farmers. Thirteen soil types were recognized in Tazewell County and seven in Clinton County and their relation to crops reported upon.

A copy of the soil map and report on the Tazewell area has been sent to one of the most intelligent and progressive landowners, with the request that the work be critically examined and freely criticised, so that we may get advice in advance of publication as to the practical utility and usefulness of the work and suggestions as to other lines that could be profitably developed.

So far as the Bureau is at present informed this work has aroused a great deal of interest, and it is believed that it will be of value to the people. Requests have been made for upward of 25,000 copies of each of these reports, with accompanying maps, to supply the local demand which is likely to arise. So much interest has been taken in this survey that urgent requests have been made by the Illinois experiment station that the work shall be continued in the State, and it is proposed to assign a party to the State for the entire field season of

nine months during the coming year. It is understood that the station will continue its cooperation, and possibly arrangements can be made for more than one party, so that the work may progress rapidly.

One of the most serious problems encountered in the soil survey, particularly in Clinton County, is in the hardpan, or the compact nature of the underlying clay subsoil, in some of the soil types. This not only renders cultivation difficult, but makes crops uncertain under certain climatic conditions, and an investigation of the cause of this and a possible remedy is now engaging the attention of the laboratories of the Bureau.

INDIANA.

No work was carried on in this State during the past fiscal year, but a party is at present engaged in making a soil survey of Posey County. This is in charge of Mr. Marean, and the whole area of the county is to be surveyed. This is particularly in the interest of the truck growers, as large quantities of watermelons and other truck crops are produced on some of the sandy soils of the area.

While there has been some demand for the extension of this work to include the whole area of the State, the plans at present contemplate a survey of only three months' duration in Boone County during the next field season.

IOWA.

During the past fiscal year a soil survey has been made around Dubuque, under the charge of Mr. E. O. Fippin. Eight soil types have been recognized and their relations to crops reported upon.

Rather strong demands have come for the continuation and extension of this work to include the entire State, but it is proposed to spend but six months during the next field season in surveying a part of Cerro Gordo and Story counties in the interest of sugar-beet production, as well as of general farming, stock raising, and dairying.

KANSAS.

During the past field season 461 square miles have been surveyed around Wichita. It was expected that this would be a very uniform area, but nine soil types were encountered, each with distinct properties and adapted more or less to different crops or requiring different methods of cultivation. The possibilities are shown of some degree of specialization of crops and the introduction of fruit interests to take the place of the almost universal crops of wheat and corn, which it is believed will be of value in the further development of the agricultural interests of the area. This work has been in charge of Mr. J. E. Lapham.

It seems desirable to spend about six months in the survey of a portion of the Parsons sheet of the Geological Survey, in the north-

central part of the State, in what may be considered the beginning of the semiarid portion of the West.

KENTUCKY.

During the past fiscal year a survey was made of Union County, which has an area of about 330 square miles, under the charge of Mr. Marean. Eight types of soil were recognized, and while apparently the soils are quite uniform in texture and natural fertility, the possibilities of introducing new industries and better methods of cultivation were clearly indicated. At present the area is given up almost exclusively to wheat culture, but there are good opportunities for greater diversification through improvements in the management of soils, the rotation of crops, and in growing products new to the area.

Demands for soil-survey work in Kentucky have been quite strong, and it seems desirable to assign a party to that State for nine months during the next field season, the surveys to include Henderson, Christian, and Scott counties. This work will be mainly in the interest of the tobacco growers, stock raisers, and general agricultural interests.

LOUISIANA.

A soil survey was made during the last fiscal year by Mr. W. H. Heileman in the Lake Charles area in the interest of the rice growers, an area of 202 square miles having been covered. Six types of soil were recognized in what was supposed to be a uniform area, and it was found that the relation of these soils to the yield of rice was quite marked, and the desirability of extending the survey to other rice districts was clearly recognized. Moreover, under the present system of exclusive rice culture, not even sufficient food for the stock is produced, while meat and vegetables for the support of the people are imported in large part from other States. There is no reason for this so far as the soils or climatic conditions are concerned, and it is pointed out that a proper diversity of interests would materially add to the welfare of the community.

It seems desirable to spend three months during the next field season in Arcadia Parish in the interest particularly of the rice, sugar, and tobacco producers.

MARYLAND.

Very strong demands have come for the continuation of the surveys in Maryland to include the whole of the State, and particularly of Worcester, Somerset, and Baltimore counties, and it is proposed to assign a party there for six months during the next field season.

During the past fiscal year Harford County, covering an area of 418 square miles, has been surveyed by a party under the charge of Mr. W. G. Smith. There is no place where the survey has been car-

ried on where more interest has been manifested and more use has been made of the work than in this State. Possibilities have been shown, particularly in Prince George, St. Mary, and Calvert counties, of the specialization of crops in the line of fruit growing, trucking, and general farming and dairying, which would very materially benefit the people and add greatly to the prosperity of the community.

While much work has already been done in this State, it is believed that the intelligent interest and appreciation shown in the results of the work justify the Department in pushing the surveys and giving the people the information they seem to need, and which they appear ready to benefit by in the practical extension of their agricultural interests and in developing the prosperity of the State.

MASSACHUSETTS.

No work has been done in this State since 1899, and the establishment of the profitable Sumatra tobacco culture has aroused a decided demand for the extension of the survey of 1899 in the Connecticut Valley northward to the State line and on either side of the area which has already been surveyed. It is proposed to spend three months during the next field season in the extension of this work, in the interest particularly of the tobacco growers.

MICHIGAN.

During the past fiscal year Allegan County, covering an area of 828 square miles, has been surveyed under the direction of Mr. E. O. Fippin. This work was undertaken particularly in the interest of the fruit growers along the lake shore and of the sugar-beet and general agricultural interests. This appears to be one of the most valuable pieces of work the Bureau has done, and it is believed that the results, which form a part of the report of the field operations for 1901, will be of very great value to the people in the extension of their present industries, the improvement of methods of cultivation, and the development of new crops, which it is believed can successfully be introduced. The experience of the people of this section will also prove of value to other communities, and the lessons taught by the soil survey will, it is believed, have value outside of the area.

No work is contemplated for this State during the next field season, but strong demands have come for an extension of the survey, and it is believed that it should be resumed at the earliest practicable time, particularly in the interest of the sugar-beet and fruit growers.

MINNESOTA.

No work has been done in the State, but strong demands have come for the extension of the soil survey, and it seems desirable to assign a party there for six months during the coming field season, the first area to be surveyed being probably Lyon County.

MISSISSIPPI.

During the past fiscal year the Bureau has mapped an area of 656 square miles around Yazoo City, the work being in charge of Mr. Jay A. Bonsteel.

About one-third of the area is in the uplands and two-thirds in the Yazoo and Mississippi Delta. The upland soil is a typical loess, and it has been suggested, as a result of the survey, that alfalfa can be produced on it as a basis for stock raising. In its present condition it is little esteemed as a cotton soil.

It was supposed that the delta would present a very uniform soil condition, but four soil types were recognized, each with very distinct agricultural values. The Yazoo clay is the most productive cotton soil, yielding from $1\frac{1}{3}$ to $1\frac{2}{3}$ bales per acre, and even more under the best methods of cultivation. This, however, covers only about 17 per cent of the delta. The Yazoo loam, covering about 6 per cent of the delta, yields from three-fourths to 1 bale of cotton per acre. The Yazoo sandy loam, covering 9 per cent of the delta, produces about three-fourths of a bale to the acre, while the Sharkey clay, covering 68 per cent of the delta, is not cultivated on account of the annual overflow. The flood waters leave the land about the 1st of June, but although the land is subsequently dry it is then too late for crops to be put in.

It has been pointed out, as a result of this soil survey, that the Yazoo sandy loam is a typical early truck soil, and that, with the prevailing climatic conditions, potatoes or other truck crops would prove a remarkably profitable industry on this soil.

The Sharkey clay is a wonderfully productive soil, and it appears from the investigations that have been made that the engineering problem of protecting it against the annual floods would not be very difficult, nor expensive when the value of the soil so reclaimed is considered. It is believed that these three suggestions, if followed by the people, will well repay the money expended in the survey.

It is proposed to continue and extend this work to include a larger area of the delta lands and possibly to take up one other area in the State, devoting in all about six months in the next field season to the work.

MISSOURI.

During the latter part of the past fiscal year Mr. Fippin was assigned to survey Howell County, in the fruit area of the Ozark region. It is probable that the whole area of this county will be surveyed during the present field season. It has been found that the soils are remarkably uniform and that the fruit interests can be extensively developed, but it is advisable that the methods be improved to attain the highest commercial success.

The demand for the continuation and extension of this work in Missouri has been so great that it seems desirable to assign a party there for nine months for the survey of Shelby, Saline, and Webster counties during the next field season.

MONTANA.

During the past fiscal year the Billings area, comprising about 105 square miles, has been surveyed under the direction of Mr. C. A. Jensen. Considerable trouble and loss has resulted from the rise of alkali in this area, and the survey was planned with particular reference to determining the possibility of preventing this trouble and reclaiming the land already damaged. It is considered quite feasible to accomplish this object, and it is probable that a demonstration will be made of the efficiency of proper drainage in preventing the rise of alkali and in reclaiming the alkali soils of this locality.

It would seem desirable to assign a party to this State for six months in the next field season to make surveys in the Gallatin Valley and in the Milk River Valley around Glasgow.

NEBRASKA.

No work has heretofore been done in this State, but it is proposed to assign a party for nine months of the next field season to make soil surveys of the Grand Island and Holdrege areas in the interest particularly of the sugar-beet industry.

NEW JERSEY.

During the fiscal year just passed a survey of the Salem area, comprising 493 square miles, was completed under the direction of Mr. Bonsteel, and a survey of the Trenton area, under the charge of Mr. Burke, has been started and will be completed during the present field season.

The Salem area lies wholly within the Coastal Plain region and has eleven different types of soil. These are adapted to various truck crops, fruit interests, and general farming. The people have already recognized the relation of the soils to crops and have adapted their industries to the various soil areas. The success has been so remarkable that the lesson may well be carried to other localities along the Atlantic coast where similar soils prevail.

The Trenton area lies partly in the Coastal Plain and partly in the Piedmont Plateau, and gives even a wider range of soils. This area is particularly adapted to specialization of crops and the building up of widely different agricultural interests.

The interest in this work justifies its continuation, and it seems desirable to spend six months during the next field season in the survey of the Monmouth Shore area, east of and immediately adjoining the Trenton area.

NEW YORK.

During the past fiscal year a soil survey was made of the Westfield area under the direction of Mr. Burke, and of the Elmira or "Big Flats" area under the direction of Mr. Mesmer.

The Chautauqua grape belt, extending for 30 miles along the Lake Erie shore, is within the first-named area. The old beaches, where the grape industry was first developed, have been outlined upon the map, and the Dunkirk clay, upon which the industry has since been developed, is also located, as well as several other foreland and upland soils adapted to general farming and dairying.

The survey of the Elmira area was undertaken particularly in the interest of the tobacco growers, and more especially to see if the cultivation of Sumatra tobacco could be extended there, and to form a basis for other tobacco investigations for the improvement of their present crops. The results indicate that the Sumatra tobacco can not successfully be produced within the area surveyed, except in one small area of not over 10 or 15 acres, where it might be grown. An experiment is in progress to determine this point, although this is not under the control of the Department. The results of the survey point to the need of further investigations of these soils, which under the present methods of cultivation require large annual applications of stable manure to produce satisfactory yields of the crops of the locality. There is an opportunity here for the work of the new division of soil management, which would probably yield results of value to the people.

During the present field season the survey has been extended to the Lyons area in the interest particularly of the sugar-beet growers. It is proposed during the coming field season to detail a party for nine months to make a soil survey of the whole of Long Island. This is particularly in the interest of the truck growers, and it is believed that the results will be of considerable interest and value.

NORTH CAROLINA.

During the past fiscal year a survey has been made of the Alamance County, Cary, and Craven areas under the direction of Mr. Coffey and of the area around Hickory under the charge of Mr. Caine.

Alamance County is in the Piedmont Plateau, and the work was undertaken in the interest of the cotton growers and general farming. Formerly this was an important bright-tobacco section, but the growth of this industry in the eastern part of the State has been the cause of a decline in tobacco production in the area, and the soils formerly adapted to this special industry have depreciated considerably in value. Various suggestions of a practical nature in the line of improved methods of cultivation and the introduction of new crops and new industries have been made as a result of the soil survey

The work in the Craven area was carried on particularly in the interest of the truck growers and in order to outline the truck soils in this area, which is not as yet very thickly settled.

The work in the Hickory area was in the interest of general farming and, in the mountainous portion, of fruit growing. It is proposed to extend this work during the present field season to the Mount Mitchell area in the interest of the fruit growers.

There is no more interesting development at the present time in the Atlantic coast States than that of the fruit interests in the mountains of Virginia, North Carolina, Georgia, and Alabama. From the work so far done in these States it is clearly apparent that the soil has an important bearing on the different fruit crops, and the apple and peach soils can be identified and outlined as a basis for the intelligent development of these industries. Not only are certain soils adapted to apples, but certain varieties of apples do better on some soils than on others, and the same is probably true of other fruits.

The North Carolina department of agriculture has cooperated very cordially and very helpfully in this work, and it appears desirable to continue this cooperation, assigning a party there for nine months during the coming field season to extend the soil survey.

NORTH DAKOTA.

Very strong demands have come from this State for the extension of the soil survey to include most of the arable portion of the State. It has been impossible until recently to start the work there, but a party has just been assigned to the Grand Forks area, in the Red River Valley, under the direction of Mr. Jensen, who has had wide experience in similar areas in Utah and Montana.

Considerable quantities of alkali are encountered, but generally at a sufficient depth below the surface to enable the annual crops to be produced. The surface foot is usually free from alkali, and as there is no irrigation, and little chance for irrigation, it is believed that there is little danger of the alkali coming to the surface and spreading. It seems a risky thing, however, to have the valuable crops of the locality growing over and so close to these alkali salts, and the possibility of the rise of this alkali should be fully investigated. If it were in an area where water was available for irrigation, it could safely be predicted that the land would quickly be injured by the rise of alkali, but with no opportunity for irrigation the chances are that conditions may not become more serious than at present. This is a question, however, that these investigations will have to solve. The work is being carried on in cooperation with the State geologist.

It seems desirable to assign a party to this State for six months' work during the next field season.

OHIO.

During the past fiscal year work has been started in the Columbus area and in the Toledo area, and it is believed these will both be completed by the end of the present field season. The surveys are being made under the direction of Mr. W. G. Smith.

The Columbus area is devoted to general farming. While there is a certain uniformity in the soils, one of the principal soils is preeminently a wheat land and another chiefly a corn land, the character of the soils showing very strongly their peculiar agricultural values in the crops produced and in the success of these crops.

It is proposed to assign a party to this State during the next field season to survey a part of Ashtabula County in the interest of the fruit and tobacco growers.

OREGON.

No surveys have been made in this State, but it is proposed to assign a party there for six months during the next field season to survey an area around Salem, in the Willamette Valley.

PENNSYLVANIA.

During the past fiscal year a survey of the Lebanon area, in the interest of tobacco growers and general farming, was completed under the direction of Mr. Smith. The interest taken in the survey around Lancaster leads me to believe that the results of this work will be found of interest and practical value in the still higher development of the agricultural conditions of the locality.

It seems desirable to assign a party for three months during the next field season to make a soil survey of Clinton County, particularly in the interest of the tobacco growers.

PORTO RICO.

During the past fiscal year an area of 330 square miles was surveyed in a strip about 10 miles wide, extending from Arecibo to Ponce, the work being in charge of Messrs. Dorsey and Mesmer. Twenty-two types of soils were recognized, all of them markedly different from the soils encountered in the United States. Much of the country is rugged, broken, and mountainous, and as there were no available maps, the base map had to be made as the soil survey progressed. Many of these soils are not well adapted to agriculture, but the report deals fully with the conditions as they were actually seen, and it is believed that it will form a basis for a more intelligent development of the agriculture of the island.

It is deemed advisable that this survey should be extended to include the whole area of the island, of which about one-tenth is included in the area already surveyed, but under a change made in the wording of

the appropriation bill it will be impossible for the Bureau of Soils to continue this work. It will be recommended that such changes be made in the next appropriation act as will enable the Department to resume operations in Porto Rico. I know of no more valuable work the Department can do than to thus investigate the actual conditions in these island possessions, and the extension of the soil survey to them should give a basis for the best and most economical development of their agricultural resources at a time when so many people are looking to these islands for investments and when the people of the islands themselves need all the help that can be given them.

SOUTH CAROLINA.

During the past fiscal year an area of 686 square miles has been surveyed around Abbeville, and on the completion of this work the party, in charge of Mr. Taylor, will make a survey of Darlington County, particularly in the interest of the bright-tobacco growers and truck growers.

It is proposed to detail a party for nine months during the coming field season to survey an area in Spartanburg, Pickens, and Orangeburg counties, particularly in the interest of the cotton, fruit, and bright-tobacco growers.

SOUTH DAKOTA.

No surveys have been carried on in this State, nor are any contemplated for the present field season. It seems desirable, however, to assign a party for a period of three months during the next field season to start a survey in Brookings County.

TENNESSEE.

During the past fiscal year a survey in the interest of the tobacco growers was made of Montgomery County, embracing an area of 547 square miles, under the direction of Mr. J. E. Lapham. Among the important results of this survey has been the suggestion that one type of soil which is at present of little agricultural value and which covers a considerable area, is adapted to fruit growing, and it is believed that this interest could be introduced with profit to the community. It was hoped that the survey would be the basis of an investigation of the possibilities of improving the tobacco interests, but the appropriation for the Bureau was not sufficient to enable this to be done.

It is proposed to extend the soil survey to Greene, Cumberland, and Davidson counties, assigning a party to this work for a period of about nine months during the coming field season.

TEXAS.

During the past field season the Willis area of 215 square miles has been surveyed in the interest of the tobacco growers, and a party of

tobacco experts has been placed there to investigate the possibility of producing a more desirable filler tobacco.

The Alvin area was also started under the direction of Mr. Bennett, and this and the Brazoria area will probably be completed during the present field season. This is particularly in the interest of the fruit growers around Alvin and of the sugar interests around Brazoria.

It is also proposed to survey an area during the present field season around Vernon, in the Panhandle of Texas, in the interest particularly of the wheat growers and with the view that the results may be useful in the introduction of macaroni wheat.

Representations have been made to the Department which make it appear advisable to assign a party to this State for at least nine months during the next field season for surveys, particularly in Tyler County, and also around Austin and San Antonio.

UTAH.

The soil-survey work of 1899 and 1900 has been discontinued in this State, but it is proposed to assign a party for six months during the next field season to survey the irrigable lands around Utah Lake.

The work around Salt Lake City is being followed up by a drainage investigation having for its object the reclamation of some of the alkali lands.

VERMONT.

A strong demand is made for the extension of the soil survey in the Connecticut Valley in the interest of the tobacco growers, to see if the cultivation of the Sumatra tobacco can not be extended to that latitude. It is proposed to assign a party for three months during the next field season to extend the soil survey of the Connecticut Valley.

VIRGINIA.

During the last fiscal year the Bedford area and the Prince Edward area have both been completed, and the Harrisonburg area has been begun. All of this work has been under the direction of Mr. C. N. Mooney. It is proposed to finish the Harrisonburg area and the northern part of the Buckingham sheet of the Geological Survey during the present field season, and to assign a party to this State for nine months during the next field season to survey the southern half of the Buckingham sheet and the whole of the Harpers Ferry sheet, as well as an area around Norfolk.

The most important work has been done on the Bedford and Harrisonburg areas. These include portions of the Piedmont Plateau, of the Valley of Virginia, and of the intervening mountain area. The results of the work on the plateau and in the valley are important, but the greatest interest centers in the survey of the mountain soils, in

which the fruit interests are developing. It has been found that the different varieties and types of fruit are best adapted to different soils, and as the survey extends and these soils are being outlined the basis is presented for the most intelligent development of the fruit interests.

The Harpers Ferry area will take in a considerable portion of the valley, as well as of the plateau, and the results of the work should show the reason for the decline in agricultural value of the valley soils, and should suggest means for reviving the agricultural interests of what was once a prosperous community on what was considered the highest type of agricultural land.

The survey around Norfolk will be in the interest of the truck growers.

WASHINGTON.

During the past fiscal year the Walla Walla area, covering about 150 square miles and including practically all of the irrigable lands of that locality, was surveyed under the direction of Mr. Holmes. The work has just been finished and the results can not yet be reported.

WISCONSIN.

No work was done in the past fiscal year in this State, but Mr. Jay A. Bonsteel was assigned on July 1 of the present fiscal year to the Janesville area to survey the soils around Janesville, Stoughton, and Edgerton. This survey is in the interest of the tobacco growers, and is particularly to see if the Sumatra tobacco is likely to be adapted to this section, and to be a basis for the improvement of the type of tobacco at present grown.

It seems desirable to assign a party to this State for six months during the next field season to make a survey, particularly of Eau Claire County.

WYOMING.

No soil surveys have as yet been made in this State, but it is proposed to assign a party for six months during the next field season to survey the soils of the irrigable part of the Laramie sheet of the Geological Survey.

ESTIMATED COST OF PROPOSED SOIL SURVEY WORK.

During the fiscal year 1902 about $40,000 was spent on the soil survey with 10 survey parties. For the fiscal year 1903 an allotment of $60,000 has been made for this work with 15 soil survey parties. For the fiscal year 1904, for which estimates are being submitted to Congress, on the basis of the plans which have just been given for the continuation and extension of the work in order to meet the most urgent demands, an allotment of $120,000 would be necessary. This is based upon a total estimate of 243 months of field work contem-

plated by the above plans, which will require for its completion within the fiscal year 30 field parties, costing approximately $4,000 each, calculated on the basis of the work done during the last three years. Each party would survey about 1,200 square miles, making a total estimated area of 34,800 square miles, or 22,272 acres, in 38 States and Territories, which would be surveyed in that year.

Publication of the Report and Maps.

The results of the field work of the Bureau of Soils are published under authority of the joint resolution of Congress providing for the printing annually of the Report of Field Operations of the Division of Soils, Department of Agriculture, approved February 23, 1901. Under the interpretation of this resolution by the Public Printer, the report and accompanying papers have to be published at one time in a single volume, with the maps in a separate case. This is undesirable in many ways, for work that is finished in the winter or spring has to be held in the office until the succeeding February, when the report of the field work is all completed and sent to the Public Printer. This delays the publication for nearly eighteen months after the work is completed, and the public interests require that the work should be published as soon as possible after the completion of the field work. Furthermore, the publication of all the reports and maps in a single volume makes a bulky and expensive book to send to any person requesting information about a particular area. The demand also is so great that, although the Department has 8,000 copies of the bound report to distribute and the Senate and House of Representatives have together 9,000 copies, the Department received upward of 2,000 requests for the 1900 report which could not be filled. Reprints were ordered of all the reports, in editions ranging from 500 to 1,500 copies, and these were quickly exhausted. As the work becomes better known, many requests are coming from Senators and Representatives, and the opinion is freely expressed that the full value of the work can not be secured unless there is a liberal provision for its distribution within the area in which the work has been done. The requests for reprints of the 1901 report indicate that from 3,000 to 10,000 copies will be required to satisfy the demand, notwithstanding the fact that some of the States are ordering reprints of the maps for their own distribution.

In view of these facts it is recommended that the joint resolution be so amended as to permit of the Report of the Field Operations of the Bureau of Soils being published in parts or volumes as the work is completed. That there should also be reprinted of the separate reports, with their accompanying illustrations and soil maps, editions sufficient to allow 500 for each Senator to whose State the survey relates, 2,000 for each Representative in whose district the survey may

be made, and 1,000 for the use of the Department of Agriculture. This will insure the prompt publication of the results of the survey and a distribution through members of Congress, which my present information seems to indicate is desirable if the full value of the soil survey work is to be attained in the dissemination of the information thus gathered, promptly and freely, to the people who are interested.

Needed Legislation for Insular Surveys.

It seems desirable that the benefits derived from the soil survey work should be extended to the insular possessions of the United States, and I recommend that the act making appropriation for the Bureau of Soils be so worded as to permit of the sending of soil survey parties to Porto Rico and Hawaii. Numerous demands have come for the extension of the work in both Porto Rico and Hawaii, and it seems probable that the work will be of particular value to these islands in the present state of the building up of their agricultural resources.

The work has already been started in Porto Rico and in the Philippine Islands, the latter through cooperation with the War Department and the civil government of the islands, in the detail of Mr. Clarence W. Dorsey to the Philippine government and the defraying of his salary and the expenses of the soil survey work by that government. The work can not be continued in Porto Rico nor started by the Department in any other of our possessions without a change in the wording of the appropriation act.

Investigations in Soil Management.

In the development of the soil survey many questions are presented of the possibility of improved methods of cultivation and handling of the crops, as well as of introducing new methods, new crops, and new industries. Some of these suggestions need more time and more study than can be given by the soil-survey parties in the limited time in which they remain in an area. Furthermore, the presentation of such suggestions in printed reports is apt to fail of securing proper recognition from the conservative farmer, who follows pretty much the methods used by himself and his predecessors on the land. Without these further studies and a practical demonstration of their efficiency many of the important results of the soil survey are liable to be lost.

For these reasons a division of soil management has been instituted in the Bureau, in charge of Prof. Franklin H. King. During the past year exceedingly delicate methods have been devised for the analyses of soils in the field. They are so sensitive that the amounts of nitrates, phosphates, sulphates, and the like which may be present, as indicated by water solutions, can be determined to within 4 or 5

pounds per acre 1 foot deep. With these methods it is possible to detect throughout the year fertilizers which were applied in the spring, and to trace the movement of these fertilizers from the place where they were applied down through the different depths of the soil. It has been found possible to show noticeable differences in the chemical composition of the soil in the same field, in some parts of which the crops are growing well, and in other parts of which they are but poorly developed. It appears that the time has arrived, looked forward to with much interest by scientists and practical men alike, when an analysis will show the need of any particular soil for certain fertilizers. It is too early to make a positive statement of this kind, but the indications are that this can soon be accomplished.

A considerable amount of work has been done with these methods on the soils of eastern North Carolina and of Wisconsin, and quite recently many of the important soil types which have been established by the Bureau in Georgia, North Carolina, South Carolina, Virginia, Maryland, New Jersey, Pennsylvania, and Wisconsin have been analyzed by these methods. These types represent all grades of soil, from the most productive to those which are quite unproductive; soils that are adapted to truck crops, tobacco, fruit, wheat, and corn; and soils under a range of climatic conditions with rainfall varying from 25 to 45 inches per annum.

The results of this work have led us to look upon the soil moisture as a great nutritive solution existing over the surface of the earth, the composition of which is everywhere approximately the same. The soil is a heterogeneous mixture of minerals, the predominant ones being silica, feldspar, mica, and other like silicates, resulting primarily from the disintegration and decomposition of igneous rocks, spread out often through the action of water over vast areas of land. All these minerals are but slightly soluble, and it is not unreasonable to expect that such a heterogeneous mixture of silicates in contact with water should yield a soil solution having sensibly the same composition and concentration. The older experimenters in Germany found that in making up solutions for water culture or for sand culture the concentration and composition of the nutritive solution must be the same within relatively narrow limits for success in plant development. The results of the past season indicate that the differences in the composition and concentration of the dissolved material in the soil moisture of various types of soil of widely different localities and of different agricultural values are little if any greater than the differences to be found in one and the same type of soil under good and under poor farm management.

The "early truck" soil of the Atlantic coast may be deficient in plant food and may require fertilizers for the best development of the crop, but even with such an application as would make these soils as

rich in plant food as the prairie soils of the Middle West, these light truck soils could not economically be made to produce as large corn crops as the prairie soils. The difference in the agricultural value of these different types appears to depend not so much upon the chemical composition as upon the physical properties of the soils, and especially upon their relation to moisture. In other words, the chemical characteristics of the soil influence the yield of crops, while the physical characteristics have generally the greater importance in determining the kind of crop adapted to the soil.

This work will require much further investigation before these statements can be definitely proved, but the amount and character of the evidence so far obtained is such that these ideas may be taken safely as working hypotheses. They are now serving us in this capacity in suggesting and giving direction to studies which are confidently believed to have far-reaching importance for agricultural methods and practice, studies which in all probability could not have been conceived or planned without the investigations which have just been briefly outlined. The results of the work indicate, as might be expected, that the composition of the soil moisture is largely influenced both by the cultivation and by the cropping of the soil, and appear to show in what way and to what extent cultivation can be depended upon to change these important characteristics.

The results of the last year's work also seem to indicate the very superficial nature of the droughts which so seriously affect crops in the Eastern and Middle Western States. It has been frequently observed that in a time of drought, when the surface soil becomes desiccated and the plants are suffering, the subsoil at a depth of 1 or 2 feet contains but little less than the average amount of moisture, and it has frequently been observed that the crops are much more shallow rooted than they are in the far West. This has been variously ascribed to the uniform texture of the soils and subsoils in arid regions, and to other reasons, but the true explanation seems to be that with our frequent and excessive rains in the spring and early part of the growing season, the crops find sufficient moisture near the surface and develop a superficial root system. When the drought comes and the surface soil loses its moisture, the crop suffers because it is not provided with a deeper root system. In the far West, where spring and summer rains are rare, the crop is planted upon a soil which is always uniformly moist to a considerable depth, and with no subsequent rains the plant develops a deeper root system, which enables it to survive long periods of drought that would seriously affect it if it was subjected to frequent showers during the early period of its growth. It is a familiar fact that a lawn which once is watered during a dry season will have to be frequently watered or the grass will suffer oftentimes more than if it had not been watered at all. The first watering induces a superficial

root development, which must be supplied frequently with water. What can be done to prevent this tendency and to overcome the effect of droughts is a subject of the utmost importance, and one which will receive the attention it deserves.

I know of no line of work which has been undertaken of more fundamental importance than the work of the division of soil management, nor one which offers a promise of more valuable results to the agricultural interests. When these fundamental problems have been established they will give a reliable basis for the development of better methods of cultivation, fertilization, and of cropping.

Tobacco Investigations.

Since my last report the commercial success of the shade-grown Sumatra tobacco in the Connecticut Valley has been assured. Last year 41 acres of shade were erected by 13 farmers, cooperating with the Department of Agriculture, 35.88 acres of which were planted to Sumatra and the rest to the ordinary Connecticut Habana seed tobacco. The expenses of this work, amounting on an average to about $657 per acre, were borne by the farmers, the Department of Agriculture exercising supervision over the work and directing all the operations. The Department also reserved the right to offer the tobacco for sale, for the purpose of obtaining official information as to the commercial value of the product, which it would have been impossible to obtain if the tobacco had been disposed of at private sale. Accordingly, after it had been carefully cured and assorted under the direction of the Department's experts, the tobacco was catalogued and offered for sale at public auction at Hartford, Conn., on May 1, in accordance with the wishes of the various growers. A committee of tobacco brokers, with Hon. E. Stevens Henry, Congressman from the First district of Connecticut, as chairman, was invited to cooperate with the Department in the management of this sale. The committee consisted of Messrs. M. E. Flaherty, New York; Steven G. Ruth, New York; S. M. Seymour, New York; Capt. Darius Ferry, New York; James Ertheiler, New York, and Herman G. Vetterlein, Philadelphia.

The committee took a great deal of interest in the work and rendered very efficient services in the matter. Credit is due them for the time and expense which they personally contributed in the interest of this investigation and of the Connecticut growers.

The tobacco was offered for sale at public auction from sworn samples. As each grower wanted to sell his crop independently of the others, many of the bales had mixed sizes and even mixed grades. Furthermore, the leaf had not been tried by the manufacturers, and there was some hesitancy in bidding on this account. This accounts for the considerable variation in the price. It is estimated by the Department's experts, as stated in Bulletin No. 20 of the Bureau of Soils, that the tobacco cost on an average, baled and ready for market,

about 51½ cents a pound. The ordinary tobacco grown in the open fields in Connecticut brings on an average from 18 to 20 cents a pound. The average price paid for the shade-grown tobacco was $1.20 a pound, the price varying from $2.80 per pound for the best to 25 cents a pound for some of the mixed bales. The crop that brought the best price sold for $1.63 per pound on the average.

On the whole, it is believed that the auction sale was very satisfactory, but it is thought that the prices for this year's crop will be even higher, as indicated by the great demands for the product and by the favorable reports that are coming in from the cigar manufacturers who have used this leaf. The aggregate of the prices obtained at the auction shows a very handsome financial transaction.

The total area cultivated in Sumatra tobacco in 1901 was 35.88 acres. There were produced 51,308 pounds of cured tobacco, and actually baled 41,046 pounds, the difference being the loss on account of fermentation, trash, and filler leaves. The total cost of production, estimated at $657.17 per acre, was $23,579.26. The total value, estimated at $1.20 per pound, the average price obtained at the sale, was $49,255.20. This gave a net profit to the growers of $25,675.94, or 108.8 per cent. This does not include the cost of the land, barns, or warehouses, nor the interest on the investment so represented, but does include the whole cost of the shade, the framework of which is expected to last for from five to eight years. The profits per acre were as follows: Of baled tobacco, exclusive of trash, there was obtained 1,144 pounds per acre; the cost of this was approximately $657.17 per acre; the value, at $1.20 per pound, was $1,372.80, giving a net profit of $715.63. The best crop, which was raised on a lot of about 6 acres, gave a yield of 1,026 pounds per acre; the estimated cost was $649.86 per acre; the total value at $1.63 per pound, the average price obtained for this lot, was $1,672.38, giving a net profit of $1,022.52 per acre.

A great deal of interest has been felt, of course, as to the experience of the cigar manufacturers in handling this product, and the reports have been anxiously awaited. Very favorable notices have been published from time to time in the press and various trade journals, but in order to obtain direct and reliable information the Department addressed three of the largest cigar manufacturers in Hartford and vicinity, who it was known had purchased some of the stock at auction. In reply to these inquiries the following letters were received:

HARTFORD, CONN., *August 25, 1902.*

DEAR SIR: I beg to inclose you my foreman's report on shade-grown tobacco. (Mitchelson, 1901 crop.) The appearance of the crop in the sheds this year shows an improvement in color; there are more brown leaves, with less of the green cast so much in evidence last season. I hope the growers will make a special effort to raise shade-grown wrappers only on land that produces a sure burn. This type is only for wrappers, and a perfect burn is quite important.

Respectfully, yours, CHARLES SOBY.

Report to Charles Soby by E. M. Roszelle, foreman of factory, on test of shade-grown wrappers, Mitchelson crop, 1901.

Shade-grown wrappers, as tested under my supervision, will show some remarkable results as to yield of product and of the effect on quality of cigars by their use. By comparison with a like quantity of imported Sumatra wrappers as to yield in product, the difference in favor of the shade-grown wrappers is apparent to all.

Our test on one bale of shade-grown wrappers of 155 pounds net weight shows the enormous yield of 85,432 cigars, an average of $29\frac{1}{3}\frac{1}{5}$ ounces per thousand. The same stock, as prepared by the tobacco strippers for the workmen's tables, shows an average of $27\frac{3}{4}$ ounces per thousand, which includes waste of all descriptions in the stripping room. Our tests on imported Sumatra wrappers of same weights show an average of 70,000 cigars to the bale, with greater loss in stem and wrappers in preparation.

In casing for the stripping room, the shade-grown wrappers take the water very nicely and show no bad effects, the wrappers being much easier handled by the caser than Sumatra. It does not become matted, but separates without any trouble.

The workmen find no difficulty in working the leaf, as no loss of time or product is caused by the use of shade-grown wrappers. The leaf is very elastic, and works well by comparison with other wrappers tested by us.

The quality of the shade wrappers is excellent, and blends very well with our binders and fillers. I am positive the cigars are improved in quality by its use. I find no trouble with the burn of the leaf in my daily inspection of the wrappers. I have failed to find a single leaf that does not burn perfectly.

As to color, they are not perfect in all respects. I find that about 91 per cent of the stock tested by us was good in color.

All things considered, the points in favor of the shade-grown wrappers may be summed up as follows:

First. Greater yield in product.

Second. Leaves are lighter in weight and color.

Third. Less waste and cost in preparation for workmen's tables.

Fourth. Less loss in weight of stems as compared with Sumatra wrappers.

Respectfully, yours,

E. M. ROSZELLE.

SUFFIELD, CONN., *September 4, 1902.*

DEAR SIR: It is but right I should advise you as to the working quality of the Connecticut shade-grown Sumatra tobacco, from which I purchased at the sale in Hartford, Conn., on May 1, 1902, 20 bales.

I have worked in my cigar factory since then quite a proportion of this tobacco, and I am more than pleased with the results. It is finer and better in every way (in color, texture, and flavor) than the imported Sumatra, and the wrapping qualities are enormous; 20 ounces will easily wrap 1,000 5-inch cigars. I am confident that when cigar manufacturers come to work this tobacco the demand will be far greater than the supply.

Very respectfully, yours,

L. P. BISSELL.

HARTFORD, CONN., *September 1, 1902.*

DEAR SIR: We have been using the shade-grown tobacco, which we bought at the auction held in this city last May, to some extent all summer. We are using it on a small "perfecto" cigar. It wraps with about 2 pounds to 1,000 cigars. The colors have improved a great deal since last spring. It burns well and tastes well. So far we have not had any complaints from any of our customers about the cigars with this wrapper. We should like it better if it had a little more body, because then it would stand the cold weather better.

Very truly, yours,

LEICHKE & PLETCHER.

In another communication Messrs. Leichke & Pletcher report that they could wrap 1,000 of their 5-inch cigars with 1 pound 10 ounces of the leaf, while Mr. Bissell, of Suffield, reported that he was using 2 pounds of the shade-grown leaf to wrap 1,000 of his cigars, and that with a bale of wrappers weighing 140 pounds 102,000 cigars were wrapped. It can safely be said, therefore, that the leaf has successfully stood the test of the cigar manufacturer.

Even before the tobacco was ready for the market or the results of the sale announced preparations were made by the growers to largely increase the acreage. Although the commercial success of the investigations had been fully demonstrated, the industry was so important and involved such an expenditure of labor and capital that, at the earnest solicitation of the growers, the Department's experts were left in the Connecticut Valley for another year to advise with such of the growers as needed their assistance. At the present time the Department is advising and instructing in this way 38 growers in Connecticut and Massachusetts, cultivating 645 acres of shade tobacco. The efforts of the Department in this direction seem to be very highly appreciated.

The season has been distinctly unfavorable. There has been an unprecedented amount of rain, falling in very severe showers, and the season as a whole has been characterized by cool spells and especially cool nights. This has apparently not affected the crop materially, as it is the general belief that the crop at this time is better than that of last year. The season has also been one of unusually severe wind and hail storms. Considerable damage has been done to the outside crops in certain sections of the State, but no damage has been done to the shaded tobacco, as the cloth has protected the leaf from all injury from hail. The damage from wind has also been exceedingly light. The winds have been so strong in places that the posts have been lifted from the ground, but the damage to the tents has been exceedingly slight and there has been practically no injury to the crop.

As to the financial prospects for this year, the following estimate is based on the experience of last year: There are about 700 acres of tobacco under shade, which will produce about 1,000,000 pounds of cured tobacco, or 800,800 pounds of baled tobacco, exclusive of trash. The total cost, at $657.17 per acre—the average for last year—will amount to $460,019. The total value of the baled tobacco at $1.20 per pound, the average price obtained at the auction, will be $960,960. The net profit will be $500,941. It is believed, however, that the cost per acre will be considerably less than last year, and that the price per pound will be greater. The Department believes that this industry has been successfully placed upon a commercial basis, and that there will be a considerable increase in the crop grown next year. We have demonstrated our ability to produce a leaf which is desired

by our people, and for which about $6,000,000 have annually been expended in foreign countries. The demand for this product has always been greater than the supply, and prices have been maintained in a remarkable manner. It may seem strange to some that manufacturers can afford to pay such prices for wrapper leaf, but even at $3 a pound for leaf that will wrap at the rate of 2 pounds to 1,000 cigars, the cost of the wrapper is about six-tenths of a cent. Even at such prices the leaf can profitably be used on a 5-cent cigar. There is so little waste to the leaf, it yields so well in the manufacture of cigars, the color is so uniform, and the grading is so perfect that manufacturers find it actually cheaper to pay $3 a pound for such leaf than to buy domestic wrappers at an average of 20 cents a pound or selected domestic wrappers at from 50 to 60 cents.

SUMATRA TOBACCO IN LOCALITIES OTHER THAN CONNECTICUT.

Considerable interest has been shown, of course, in the possibility of extending the Sumatra tobacco industry to other localities and to other States. It was predicted, as a result of the soil survey of the Lancaster area, Pennsylvania, that the Sumatra tobacco could be successfully grown under shade on the narrow strip of Donegal gravelly loam bordering the Susquehanna River. Experiments carried on this year by the Pennsylvania experiment station, in cooperation with this Department, in growing Sumatra tobacco under shade on a small tract of about 1 acre appear to have demonstrated the correctness of this prediction. The crop has been harvested and, judging from the product in the curing shed, it is of good quality. It is not believed by the Department experts that equally successful results will be attained on other soils in this area.

In response to demands from one of the principal New York tobacco districts, a soil survey was made this season of the Big Flats area in the Chemung Valley, New York. As a result of this survey, it is not believed by the Department experts that any considerable success will attend the growing of Sumatra tobacco on the soils of that locality, with the exception of a very small area of not exceeding 10 acres, where an experiment has been actually carried on by a gentleman familiar with the soils of the Connecticut Valley, who selected this tract because it represents the type of land that is found in Connecticut.

A soil survey has also been made of a considerable area in the Janesville area, Wisconsin. Two experiments of growing Sumatra tobacco under shade have been tried there, and the results at the time of harvesting indicate a fair degree of success. The Department does not believe, however, that the product of the soils of the Janesville area will approach in quality or in value the product raised in the Connecticut Valley. It is not intended by this to imply that the leaf can not be successfully grown in the Wisconsin area, but from

the information at present obtainable it does not seem that the product will be of equal value with that of the Connecticut Valley. The Department is still of the opinion that the conditions essential for the raising of a high grade of Sumatra tobacco are limited in extent and can be closely defined by the soil survey.

INVESTIGATIONS IN THE FILLER TOBACCO DISTRICTS.

The experiment of raising Cuban filler in Lancaster County, Pa., last year was not a success. It is believed, however, that this was due to a misunderstanding with the growers and a consequent lack of care and thoroughness in the cultivation and handling of the crop. While it was thought that these investigations should not have been interrupted or discouragement felt at the lack of success in this first attempt, it was impossible for financial reasons to maintain a party in Pennsylvania, as a promise had already been given to start the work in Ohio. Accordingly, more careful plans were made, and a crop was grown on the upland soils of the Miami Valley, under the direct and immediate supervision of the Department's experts. This crop has just been harvested, and it is too early to determine the value of the product. From other crops that have been raised in the locality from imported Cuban seed, which have been fermented by our experts and thoroughly examined, it would appear that a desirable type of leaf, approaching very closely the imported Cuban leaf, can be produced. The quality of the leaf is not at present all that could be desired. There is something harsh about the aroma, but it is thought that this can be considerably toned down, if not entirely eliminated, by thorough methods of cultivation and fermentation.

The tobacco situation in Texas has been thoroughly studied, and it is thought that a desirable leaf will be produced there by careful methods of cultivation, fermentation, and assorting.

CONFERENCE OF TOBACCO EXPERTS.

A conference has recently been held in Washington by the tobacco experts of the Department to consider the general situation and to advise as to the methods to be pursued during next season, especially in Ohio and Texas. Arrangements have been made for experimentation during the coming crop season with good prospects of producing fine filler tobacco in these two States. Leaf has been grown that can not be distinguished from the imported Cuban when properly fermented.

SALARIES OF TOBACCO EXPERTS.

The demand for experts to carry on tobacco investigations has been so great that Mr. Floyd, although receiving as high a salary as, in justice to other officers of departments, it seemed possible to pay him,

and who at the time was getting a larger salary than the Chief of the Bureau who was directing the work, was induced to leave by the offer of compensation about three times as great as he was receiving in the Department. Quite recently his successor has been approached in the same way by a corporation intending to operate in the Connecticut Valley, and it is likely that he will leave the Department to accept a much more remunerative position outside. Two years ago I had to note the loss to the Department of a gentleman who had made some important discoveries in tobacco fermentation, and who was called to Japan at a salary about four times as great as he was receiving in the Department.

It is gratifying to feel that the Department's experts are looked upon with such favor in the commercial world, but these experts are so difficult to obtain, and to train them requires so long a time, that the Department is very greatly embarrassed when they are thus removed because of lack of opportunity to pay them what their services are worth in commercial lines. As this work has been developed by the Department, it seems strange to think that the very success of the work is hindering, if it does not prevent, the successful extension of the investigations.

EXTENSION OF THE TOBACCO INVESTIGATIONS.

The tobacco investigations of the past two years have been carried on with three field parties, at a cost of about $5,000 each, or an aggregate of $15,000 per annum. On account of the great success of this work, and the extraordinary interest taken in its extension to other areas, I recommended last year that the appropriations for the Bureau of Soils be increased so that the allotments for this work could be made sufficient for seven parties of tobacco experts. The appropriations as passed, however, did not allow of this increase, and the allotment this year has been the same as for last. The demands for the services of these tobacco experts have been very great, and I would recommend that three additional parties be organized for work in Pennsylvania, Wisconsin, and North Carolina. This will mean an increase of $15,000 in the allotment, making in all the sum of $30,000 for the tobacco investigations. I feel that the economic results of the work so far done, and the lines of work that are at present being developed, fully justify this recommendation. The reports from the Connecticut Valley alone indicate that nearly $1,000,000 worth of Sumatra tobacco will be grown in the State this year. This has largely increased the price of land; has furnished a market for thousands of chestnut posts from adjacent ridges which have lain idle and unproductive for years; has given employment in a healthful occupation and at remunerative wages to large numbers of men and women; has brought about the production of millions of square yards of cloth by the cloth manufac-

turers, and has opened up the possibility of an enormously profitable industry for the future. It would seem that this experiment alone would fully justify the increase in the allotment that is asked, but when it is stated that we expend annually $8,000,000 for filler tobacco which the experts of the Department believe can be produced in this country, it but adds to the justification of the request for the larger allotment for this work.

Drainage Investigations.

During the year an investigation was started as to the possibility and practicability of reclaiming the soils in the arid regions which have been injured by seepage water and the accumulation of alkali. In cooperation with the Utah experiment station and Mr. C. D. Swann, of Salt Lake City, who has donated land for the purpose and has paid a considerable portion of the field expenses, a tract of 40 acres of alkali land near Salt Lake City has been thoroughly underdrained with tile. This work has been under the immediate supervision of the Department experts, and the work of reclamation is to be under the joint charge of the Department and the Utah experiment station. It is too early yet to speak of the results of this work. It is being watched with the greatest interest by the people of that locality, and it is believed that if the investigation is a success ample capital will be forthcoming to carry on extensive operations in the reclamation of alkali tracts and the prevention of damage to irrigated lands from seepage waters. This work is under the immediate charge of Mr. W. H. Heileman.

Arrangements are being made for the carrying on of similar work at Fresno, Cal., and it is proposed to extend this work to a typical area in Montana and possibly in Arizona, to demonstrate to the people that these unfavorable conditions can be economically controlled. It is estimated that land values in the immediate vicinity of Salt Lake City will be increased at least $3,000,000, exclusive of the cost of reclamation, if they can be reclaimed from the alkali with which they are now impregnated, and it is believed that equally great benefits will result in other portions of the arid West.

In furtherance of this work, Mr. Thomas H. Means, of the Bureau of Soils, has accompanied Mr. Thomas H. Kearney, of the Bureau of Plant Industry, on a trip to Algeria and Egypt to study the treatment of alkali lands, the use of alkaline waters in irrigation, the methods used in the reclamation from seepage water and alkali, and the crops adapted to alkali soils. This investigation has not yet been completed, but sufficient has been heard from the party to indicate that conditions even more serious than those existing in the arid regions of this country are under perfect control, and it is believed that the information thus gathered will be of great benefit to the people of Western America.

BUREAU OF CHEMISTRY.

Examination of Imported Food Products.

The Bureau of Chemistry has continued the examination of imported food products for the purpose of determining if they contain any added substances injurious to health. The Bureau has also collaborated with the Treasury Department in controlling the polarizations of imported sugars and in determining the character of certain other imported products in order to classify them for dutiable purposes. Investigations of the adulteration of food products is one of the important studies of this Bureau, and the work has been especially devoted during the past year to the adulterations of olive oils, with the object of securing an honest market for the olive oils of domestic manufacture which are compelled to compete with cheaper and adulterated oils.

Investigations of Forest Products.

Important investigations, in cooperation with the Bureau of Forestry, have been conducted by this Bureau in connection with economic forest products such as tannin, gums, rubbers, and wood pulps.

Laboratory Tests of Road Materials.

The road material laboratory of this Bureau, which was established in December, 1900, in cooperation with the Office of Public Road Inquiries, tests road materials of all descriptions, free of charge, for practical road builders throughout the country.

Those interested in the construction of a road have only to send samples of their available materials to this laboratory and have the road-making qualities of these materials determined. In the case of materials for macadam roads, the resistance of wear to rock, its cementing value, hardness, toughness, and absorptiveness are determined. After such tests are made it is possible to predict which material will give the best practical results under a given traffic.

Only practical road builders of much experience realize the large amount of money which can be wasted through an improper selection of material. There are generally several materials available in every locality, and the difficulty of selecting the most suitable for a particular road is evident. The only way a proper selection can be made within a reasonable time is by means of physical and chemical laboratory tests.

The laboratory is now equipped for the testing of road materials of every description, as well as cement and concrete for drains and highway bridges.

The large number of samples received from all parts of the country, including our island possessions, attest the value which practical road builders place upon these laboratory tests.

Investigations in the Sugar Laboratory.

Important investigations looking to improving the quantity and quality of table sirups have been made in the sugar laboratory, and critical studies have been undertaken of the influences tending to produce the maximum content of sugar in beets, melons, and other sugar-producing plants.

Studies of Insecticides.

Studies of the various insecticides in common use in agriculture have been conducted with the object of determining the value of their constituents. Since arsenious acid is one of the most common constituents of insecticides, an investigation has been commenced to determine the effect of this body upon the foliage of plants and to ascertain whether any of the arsenic thus applied for insecticidal purposes is found in the food products derived from the plants which have been thus treated.

Study of Environment of Chemical Composition of Cereals.

Extensive collaborative work has been instituted with many of the agricultural experiment stations for the study of the effect of environment on chemical composition of wheat and other cereals and to ascertain the most reliable methods for judging the quality of the soils from their chemical constitution.

Study of Waters used in Irrigation.

The study of the character of waters used in irrigation, especially in the growing of rice, has been begun, to determine the quantity of injurious salts which these waters may contain and the quantities of this water which may be safely used upon the fields.

Establishment of New Laboratories.

New laboratories have been established to study the effects of preservatives and other added substances upon the health of the consumer, with the view of determining the character and amount of such substances which may be safely used in such foods without injury to public health.

A contract laboratory has also been established for the purpose of ascertaining the quality and quantity of materials purchased for the Department of Agriculture and other Departments of the Government, and to establish specifications for such supplies, based on physical and chemical properties.

A drug laboratory has been established also to study the character, standard, and adulteration of drug products. The larger portion of the drugs in commerce are of agricultural and horticultural origin, and

the necessity of securing purity and conformity to standards in articles of this kind is evident. Dangerous narcotics and poisonous substances should not be indiscriminately sold, and drugs intended for ordinary therapeutical purposes should conform to the standards laid down by competent authorities.

Work for Other Departments.

The Bureau of Chemistry is constantly increasing the services rendered to other Departments of the Government. This is especially true in respect of its collaborative work with the Treasury Department in controlling the polarizations of sugars, and in assisting the appraisers in the classification of other imported articles where the rate of duty depends upon chemical and physical characters.

Extensive studies have also been conducted for the Post-Office Department in regard to the character of canceling inks and stamps used therewith. Similar investigations have been conducted for the Bureau of Engraving and Printing in regard to colors used for printing bank notes, bonds, and other Government securities.

All of this work is of a nature which is highly important to the public service, and is conducted largely on agricultural products.

DIVISION OF ENTOMOLOGY.

Work on Insects from Abroad.

THE SAN JOSE SCALE AND ITS ASIATIC LADYBIRD ENEMY.

In the report of last year attention was called to the exploration which was being conducted by the First Assistant Entomologist, Mr. Marlatt, in Japan and China, to discover, if possible, the native home of the San Jose scale (*Aspidiotus perniciosus*), and also to find native parasites and enemies which might be imported to control or at least check the damage which is done by this insect in the deciduous orchards of this country. Mr. Marlatt's exploration of Japan demonstrated that the San Jose scale is not a native of that country, as many of our entomologists had supposed, but, on the contrary, that it had come to Japan comparatively recently on imported nursery stock, and been thus spread somewhat generally over the islands of the Japanese Empire. Subsequent to the time covered by the report for 1901, viz, in the late summer and fall of that year, Mr. Marlatt extended his explorations to China, examining the coast region from Shanghai northward to Pekin. The evidence from native fruits and wild plants in the region about Pekin and south of the Great Wall established very clearly that the original home of the San Jose scale was in this region.

In brief, this scale insect was found on wild haw apples, native

crab apples, and native pears grown in the region indicated where no foreign fruit stock had ever been introduced. Furthermore, it was found in scattering numbers everywhere, just as one would expect in the native home of a pest of this sort where it is normally kept in check by natural enemies. There can be no doubt that at last its original home has been located. It was probably brought to America many years ago on imported Chinese flowering peaches or some other ornamental or flowering shrub from this region, having first appeared in the gardens of a great importer of ornamental and other plants in San Jose, Cal. A very interesting fact in connection with this discovery was the finding in this same region of a ladybird which preys on it naturally and seems to be the principal agent in preventing its often becoming very abundant and injurious. This ladybird (*Chilocorus similis*), a European and Asiatic species, in China feeds naturally on the San Jose scale and related forms, as also on the white peach scale, a very troublesome pest, which has recently gained foothold in our Eastern and Southern States. Several shipments of this beetle were made by Mr. Marlatt, some from Japan and some from China. Unfortunately, all perished but two, this mortality resulting from the long confinement of the six or seven weeks' trip from Asia and the unfavorable conditions under which they were kept in Washington during the winter.

From the two surviving individuals more than 2,000 beetles and larvæ are now on scale-covered trees on the Department grounds. In addition to these, shipments of some thousand beetles have been already made to other points in the East, a number of experiment station entomologists having expressed a desire to assist in the work of propagating, distributing, and establishing this useful ladybird. This importation promises most flattering results at present. It is, however, still an experiment, and what the ultimate benefit will be can only be determined after a two or three years' test. We hope to establish this ladybird in this country and to get from it some of the good results, at least, which it evidently accomplishes in China and Japan. It probably will not render it unnecessary in the future to occasionally spray or otherwise treat infested trees in commercial orchards, but it probably will be of very great assistance in keeping in check the San Jose scale in the thousands of gardens and small orchards of individuals who have no commercial interest at stake and who would not, ordinarily, take any means to keep this scale insect from multiplying on their trees, thus forming centers for contagion.

IMPORTATIONS OF OTHER BENEFICIAL INSECTS.

The preliminary attempts to introduce the European enemies of the gipsy moth have been continued. The difficulties attending the importation of the predaceous beetles from Europe to America are consid-

erable, and to get them established in this country will demand the careful cooperation of agents or interested individuals on the other side.

The black scale of the orange is the most destructive, perhaps, of all the orange pests in California, and the South African parasite of this scale insect, which we have been endeavoring to establish in California for the last year or two, still gives promise of ultimately becoming a fixture and doing the good service in our Western orange districts which it now does in South Africa and in Italy. The history of this importation was given in my report of last year. A recent letter from Mr. Alexander Craw, who is looking out for this experiment in California, reports that the parasite is breeding abundantly. With a beginning of only two female insects kept in captivity, he had sent out to different localities up to July of this year (1902) 25 colonies.

The very important European parasite of the larger scale insects such as the Lecaniums and mealy bugs (*Erastria scitula*) seems on the way to be successfully established in California. It is believed that the introduction of this insect into our citrus and olive districts will be of the greatest advantage to the growers of these fruits. With the cooperation of Mr. Craw, the horticultural quarantine officer, and Mr. Ehrhorn, of Santa Clara, these insects have already been liberated in Santa Clara, Los Angeles, and Niles, Cal., and the outcome of this effort at the introduction of a useful insect will be watched with interest, and the utmost care will be taken to bring it to a successful issue.

Another foreign insect promising great usefulness in a different direction, imported during the past year, is the European ladybird (*Coccinella septempunctata*) sent from Hungary through the kindness of Professor Sajo. These ladybirds feed on plant lice, and should be an efficient aid in controlling the destructive insects of this class which infest cotton, peas, melons, and other vegetables, and the fruits. Some of these insects have been sent to Mr. Craw, in California, where they give promise of becoming established; others to various Eastern experiment station entomologists, and they have also been colonized in the District of Columbia. Another ladybird (*Leis conformis*), a plant-lice feeder also, was imported from Italy and liberated in California. A further importation of this species may be necessary to effect its establishment here.

This entomological work of an international character has not been altogether one-sided. In other words, while we have been importing foreign insects and have been receiving a good deal of gratuitous assistance by entomologists abroad in this work, we have paid our debts, to a certain extent, by sending to foreign countries some of our beneficial insects. The extraordinary success in preventing damage from the white scale, once a great orange pest in California, by the introduction of the Australian ladybird, has been duplicated, as made evident

in former reports, in many foreign lands, notably South Africa, Portugal, and Egypt. During the last year colonies were sent from California, at our request, to Dr. Antonio Berlese, Portici, Italy, where this same white scale had established itself. Recent reports indicate that this exportation has proved to be another of the series of successes which has attended this insect wherever it has been sent to work against its notable scale-insect host. A colony of this ladybird has recently been sent, by request of the local board of agriculture, to Papeiti, Society Islands. We have also had sent, through the kindness of Mr. Craw, various beneficial ladybirds to the Bermuda Islands to assist in keeping in check the noxious scale insects occurring on those islands.

The South African Grasshopper Fungus.

The report of last year noted the beginning of an experiment to determine the effectiveness of the African grasshopper fungus as a means of destroying various forms of destructive locusts. The experiment has been continued the present year and much extended, the intention being to give this fungus a thorough and practical test to demonstrate whether it can really be counted on as a means of controlling the locust or not. The number of experimenters last year during the entire season was 223. During the summer of 1902 cultures of the fungus were sent to nearly 1,000 individuals, not including the perhaps even greater number of cultures which have been locally prepared by various individuals, and especially by Prof. C. P. Gillette, of the Colorado State Agricultural College, who has taken charge of the culture preparations and their distribution in his State. These cultures have been sent out to 25 different States and Territories. Results have not yet been tabulated, but some successes have been reported. It now seems probable that very great reliance can not be placed on this fungous disease. Either it does not work with our grasshoppers as readily as it does with the South African locust or our climate makes our species of grasshopper more resistant or the fungus less operative.

The Fig Fertilizing Insect.

As a further report of progress on the introduction and establishment of the fig-fertilizing insect in California referred to in previous reports and especially summarized in the report for 1901, it may be said for the year 1902 that thousands of figs containing the insects successfully withstood the winter climate of California, and an unlimited amount of fig insects was available at the proper time for caprification in the spring of 1902, resulting in the production of some 50 tons of Smyrna figs in the sole commercial orchard in existence at present, that of Mr. George C. Roeding, at Fresno. It was further found that

the fig insect successfully hibernates at Niles, Cal., and there is now no longer any danger of its dying out. In other words, the entomological problem of Smyrna fig culture in America is solved, and what remains to be done belongs rather to the domain of horticulture, namely, the introduction of more caprifig trees, improvement in the methods of curing and drying the fruit, and the determination of the regions throughout the arid West suitable to the industry. The practical success of Smyrna fig culture in California is now only a matter of time. In a very few years Smyrna fig orchards will be in bearing in many places in California and doubtless in other Western States where climatic conditions are favorable.

As stated in the report for 1901, Mr. Roeding spent nearly a year in Smyrna studying the methods of fig culture in that country under a commission from this Department. Much valuable data was obtained, for the most part appertaining to the horticultural side of the problem. The future of this industry, which promises to be one of the great ones of the arid region of the West, becomes more promising every year.

Work on the Mexican Cotton Boll Weevil.

The work on the Mexican cotton boll weevil reported in 1901 has been continued, and has the present season been given a very practical status by means of the specific appropriation by Congress for the purpose of $20,000. A field experiment is being conducted on two cotton plantations, one of 200 and the other of 125 acres, under the control and direct management of the Entomologist, to demonstrate that by proper methods the damage from the boll weevil can be so reduced as not to be a serious menace to the production of this important staple in the region in Texas already invaded by the weevil.

In spite of the delayed beginning this year, owing to the late date at which the appropriation was available, the entomological side of this field experiment has been thoroughly successful, and the weevil has been practically eliminated from the plantations under Departmental control. The cotton season, however, in Texas has been the most disastrous one climatically in twenty-five years, and this will prevent the cotton yield on these plantations coming up to the average, the lessened yield, however, in no wise being chargeable to the boll weevil. It is urged that the means for continuing this investigation be provided, as it is one of the very greatest importance for the whole cotton industry of the South. There can be very little doubt but that ultimately the Mexican boll weevil will spread to the adjoining State of Louisiana, and thence across the cotton belt east of the Mississippi, and is capable of becoming one of the most destructive insects in America. If, on the other hand, the Department can demonstrate by practical field work that the weevil can be controlled, as indicated by

the preliminary experiment this year, it will have the effect of influencing planters generally, in Texas and elsewhere, to adopt the same methods, and thus avoid much of the loss which this insect threatens.

In this connection, reference may be made to the Egyptian cotton which, by newspaper report and otherwise, has been somewhat exploited as immune to the boll weevil. This misconception is capable of doing harm, inasmuch as the Egyptian cotton is rather more subject to weevil damage than the variety of cotton ordinarily grown in Texas. In a field of Egyptian cotton near San Antonio practically every square was punctured by December 12, and the weevils had begun to attack the bolls, half of which had at that date been destroyed. The fact that Egyptian cotton seems to be later in maturing than the smaller American plant causes it to be much more liable to damage by the boll weevil. The same conditions with Egyptian cotton were also noted on another plantation.

In the fall of 1902, after the close of the active field work of the season, the agent in charge made some very desirable explorations in Mexico, more especially to investigate the subject of natural enemies. Important biological and life history studies have been prosecuted in Texas and the present range of the insect has been carefully mapped.

Work on the Codling Moth in the Northwest.

The work done on the codling moth in the Northwest has been continued with very satisfactory results. A detailed report of this work has been published. The work the present year has been of a very practical character, a successful orchard demonstration having been conducted which showed that it is possible to prevent much of the damage which is now annually suffered from the codling moth.

Work on Insects Damaging Forests.

During the first half of the year several important investigations were made of forest insect depredations by Dr. A. D. Hopkins, of the West Virginia experiment station, who was employed at the request of Mr. Gifford Pinchot, of the Bureau of Forestry, as a temporary agent of the Division of Entomology for the purpose. Great loss of pine timber, to the amount of more than 600,000,000 feet (board measure) in the Black Hills Forest Reserve, has resulted from the work of a bark-beetle mining under the bark of living trees. Numerous facts have been determined relative to the life history of this insect, and it has been possible to detail practical methods, the adoption of which will largely decrease future losses. A report of this investigation has been published.

Another investigation was of hickory and other forest trees near Geneseo, N. Y. The hickories had been killed by a bark beetle, the damage having already gone beyond repair for most of the region

invaded. Had an earlier report of the difficulty been made to the office, a prompt application of known methods of control would have prevented this loss. A special report of this investigation will soon be published. The damage occasioned by this hickory bark beetle seems to be quite general throughout the Northern United States, and will receive considerable attention in the future, especially now that Dr. Hopkins has been regularly appointed to the Division of Entomology as expert in forestry insects. A study of the insect enemies of Eastern, Southern, and Western pine forests has been begun to determine, if possible, the primary causes of the serious insect damage now being done to pine timber of western North and South Carolina, northern Georgia, southern Florida, the white pine or silver pine of the Pacific slope, the Monterey pine, California, and the pines of Arizona and Colorado. The regions designated have been given a preliminary survey to determine existing conditions, and it is expected that by the close of the next fiscal year it will be possible to have a report ready for publication on the principal pine insects of North America, which will include brief popular descriptions of the more important insects, with illustrations, and recommendations for preventing losses.

Work on Scale Insects.

The important work of the year on scale insects has been the investigation of the San Jose scale in China and Japan, referred to under "Work on insects from abroad." The experimental work on the San Jose scale at home has been continued, and a circular (No. 42) describing the methods of controlling this insect has been revised to include the results of the latest information on methods of treatment.

The Division of Entomology of this Department is looked upon as the chief source of information upon scale insects, few of the experiment stations having collections or literature sufficient to enable the determination of specimens; hence much work is done every year in determining material for station entomologists and for private individuals throughout the country. In addition, many large collections of scale insects have been received for study and determination from foreign countries, notably from Australia, New Zealand, the Bermudas, and Italy.

In the course of the trip of exploration made by Mr. Marlatt in Japan and China, Java, and other countries in the Orient, a particular study was made of the scale enemies of citrus and other fruit trees, and large collections of this class of pests were brought home from the countries visited. The knowledge gained from this study will be of great practical importance. It will acquaint us with the scale pests of these countries, which are being brought into closer commercial relations with the United States, a knowledge which is desirable because these

insects are more apt in the future than in the past to reach our shores through importations of fruit trees and ornamental stock. The scale insects of foreign countries are perhaps the most important pests to be considered in all quarantine and other operations looking to the protection of our growers from foreign invasions, since these insects live for the most part attached to the bark of trees and are much more apt to be brought in with plants than are other insects.

Insects Injurious to Shade Trees.

Many complaints of insects affecting shade trees have been received in recent years, and among these are several important foreign species, which have been under investigation during the year.

Insects Injurious to Truck Crops.

The studies already under way on destructive insects affecting truck crops have been actively followed up, and an extensive report on the principal insects that have recently been injurious to vegetable crops has recently been issued. A number of insects injurious to leguminous food crops received considerable attention, and the new facts discovered in the life histories of some of them are of value in suggesting means of control.

Work on Insects Injurious to Stored Products.

Certain insects of this class are increasing their ravages. The Mediterranean flour moth, which is the most troublesome of all insects that are harmful in flouring mills, was reported as injurious in mills in new localities in California, and in Michigan, Wisconsin, and Minnesota. The Angoumois grain moth has also increased in injuriousness in a number of States, particularly northward and in California.

The cigarette beetle has been very destructive during the past season. Thorough investigations were conducted with a view to find a remedy for this pest, and much of value was learned and published.

An exotic cabinet beetle did much injury to silk in New Jersey and to domestic tanned leather in New York City, its introduction being traceable to the introduction of foreign hides. In the treatment of the insects which affect stored products, recent experiments with hydrocyanic-acid gas indicate that this remedy may, in course of time, be found more valuable than the bisulphide of carbon usually employed in the treatment of many such insects.

Work on Insects in their Direct Relation to the Health of Man.

Insects as conveyers of disease to human beings have been the subject of special research by the Entomologist for the past three years. A popular article on this topic was published in the Yearbook for

1901, and has since been reprinted in more popular form. During the past summer many inquiries have been received requesting information and advice on the subject of mosquito and fly control, and these have been answered by the publication in question and by specific advice. This investigation is being actively prosecuted; the field is a very large one and of the greatest importance. While perhaps the principal insects responsible for the transmission of disease have received study, there remains very much yet to be learned of them, and, furthermore, the Entomologist is in frequent receipt of new material from this and other countries, and is constantly discovering new facts bearing on this general problem.

Unclassified Work on Injurious Insects.

During the fiscal year investigations were taken up on supposed insect damage to cocoanut and other palms in Cuba, Florida, and in British Honduras. An article on the principal insects which act as disseminators of the trouble locally termed "fever," and due to a fungous disease, includes suggestions for methods of prevention of the dissemination of the disease.

Insect Determinations.

An important line of work is the identification and maintenance of records of the habits of injurious insects received from correspondents, field agents, and others to serve as a basis for determining the best means of controlling them. During the fiscal year 226 species not hitherto studied at this Department received more or less attention, and the catalogue number of biological series thus studied now reaches 9,667.

The time of two expert assistant entomologists and several minor assistants and aids is devoted to the preparation of material for permanent storage in the United States National Museum, for exchange with other institutions, and for illustration and description.

Experimental Work with Insecticides.

During the year a considerable number of experiments with insecticides and other methods of controlling insect depredations have been conducted. A great many insecticide substances are constantly being advertised, and many of them are sent to the Entomologist for experimental examination and test either from purchasers or the manufacturers. Most of these are of very little value, or are combinations of old and well-known insecticide substances, sold, however, as a rule, under their new form at many times their real cost. The assistance of the Chemist has been invoked to determine the composition of these substances, and he has recently established a special section for insec-

ticide analysis and investigation in cooperation with the Division of Entomology.

To determine the feasibility of eradicating household insects by fumigation with hydrocyanic-acid gas several valuable experimental operations have been conducted, with the result of the establishment of the complete practicability of disinfecting houses by this means. This poisonous gas can be used without risk to human life if the operation is carried on with proper precautions, but no one is advised to undertake it without having fully acquainted himself with the steps in the process as indicated in Circular No. 46 of the Entomologist's office.

Silk Investigations.

The silk investigations authorized by the last Congress have been placed in the charge of the Entomologist. Miss Henrietta A. Kelly has been employed as special agent in silk culture in the South, and is charged with the preparation of a manual of instructions which it is expected will be ready for publication and distribution this fall. She will also look over the ground and select suitable locations for model silk plantations and rearing establishments which may serve as schools of instruction where interested persons and others may come and acquire familiarity with all the steps in the care of caterpillars and the handling of cocoons. The Entomologist, Dr. Howard, during the summer made a careful examination of the silk industry of southern France and of Italy, studying especially the methods of reeling silk and silk manufacturing establishments, mulberry culture, and breeding methods. He has also arranged for the purchase of "seed" or silkworm eggs which can be relied upon as free from disease, and has negotiated for the importation of desirable mulberry stock. It is the intention to follow up this investigation by establishing experimental stations in the South, by cooperative work with some of the agricultural experiment stations which have expressed the wish to assist us in the investigation of silk culture, and also to establish at some suitable point a practicable reeling plant so that the silk cocoons produced in small quantities may be purchased and reeled and the product marketed.

Apicultural Investigations.

In apiculture the work has included an importation of select breeding queens from Italy and smaller importations from Austria and Cyprus. These were forwarded to experiment stations and to bee raisers in different sections of the country. Very favorable reports from these queens have been received, notably from southern California, where, it was stated, while black bees were doing nothing, the Cyprians from the Department importation gathered a fair crop, double the yield also of the best Italians. Various crosses were made

between these races and some promising strains secured, one result being that the irritability of some excellent honey gatherers can be modified by using males of gentler races in the crosses.

DIVISION OF BIOLOGICAL SURVEY.

The Biological Survey is charged by Congress with three distinct lines of investigation, each of which is organized as an independent section of coordinate value with the ordinary Departmental division. The first, or Biological Survey proper, studies the geographical distribution of mammals, birds, and plants with reference to the climatic factors governing distribution, and from this study prepares maps showing the boundaries of the natural life zones and crop belts of the country; the second, or Section of Economic Ornithology, studies the food and food habits of birds with relation to agriculture and horticulture; the third deals with matters of game preservation and introduction.

Biological Survey.

California and Texas, owing to their great size, the diversity and commercial value of their agricultural products, and their promise of far greater development in future, have unusual claims on the Biological Survey. In California the work is peculiarly difficult by reason of the extraordinary diversity of the topography and climatic conditions. Not only are there torrid valleys below the level of the sea, and alpine summits towering to elevations above the limit of plant growth; there are also areas of excessive humidity, of frequent fogs and heavy rainfall, and areas of excessive aridity, hotter and drier than the Sahara, where perpetual sunshine is the rule and years sometimes pass without rain.

Owing to the trend of the principal mountains and the influence of the coast fogs, the zones run in the main north and south instead of east and west. Some of the large interior valleys, notably the Salinas, act as flues through which a great volume of fog flows daily at certain seasons, lowering the temperature and increasing the humidity for a distance of 75 miles or more. These great rivers of fog cut off the sun, lower the temperature, and increase the humidity, and by overflowing through canyons and side valleys also reach and exert their influence in numerous tributary valleys and basins, some of which lie between the main fog river and the coast. In these cases the usual conditions are reversed, for ordinarily the valleys of the coast ranges in retreating from the sea toward the interior receive less and less fog and more and more heat and sunshine. Each valley and each mountain slope therefore has its own climatic individuality and its own capacity or adaptability for particular agricultural and horticultural crops. Some are cool enough for apples, cherries, and the sugar beet;

others warm enough for almonds, raisin grapes, and citrus fruits. And in the case of some of those in which the same crops may be cultivated with equal success, these crops mature at widely different dates. Thus oranges ripen in southern California from January to April; on the Santa Barbara plain, in July and August; at Oroville, in November and December. Similarly, peaches mature at different points in northern California from May to September, and in Los Angeles as late as November. Cherries are ready for market in Vaca Valley in March and April, while in neighboring valleys they do not ripen until May and June. The great commercial importance of these differences in time of ripening of fruits is obvious.

The native fauna and flora of a region afford a suggestion as to its climatic peculiarities and agricultural possibilities, assisting one to conclude what farm crops and varieties of fruit will or will not be likely to succeed in a particular place. The Biological Survey is making a critical study of this subject, and is engaged in the preparation of maps showing the natural distribution of the faunal and floral areas and consequent courses of the crop belts, and is also preparing lists of the particular kinds and varieties of crops and fruits likely to succeed in each. The labor of tracing the zone boundaries in California is one of infinite detail, and is rendered still more difficult by the absence of accurate topographic base maps, except of the areas already mapped by the United States Geological Survey.

In addition to the work in California and Texas, some field work has been done in Montana, the Dakotas, Nebraska, Kansas, Indian Territory, New Mexico, Mexico, and Canada.

THE PRAIRIE DOG SCOURGE.

The extension of ranching on the Great Plains has led to serious, widespread, and reiterated complaints of steadily increasing losses from the depredations of prairie dogs. The increase in these pests is the natural result of the destruction of their enemies, chiefly coyotes and the larger hawks. Assistants were sent to various points in the afflicted area, from Montana to Texas, and much information was collected. As a result a circular of directions for the destruction of prairie dogs has been published, and an article on the subject was contributed to the Yearbook for 1901.

Section of Economic Ornithology.

During the year field work on the food habits of birds has been carried on in California and Maryland, and the stomachs of considerably more than 2,000 birds have been examined in the laboratory. Of these, 1,000 were of the game birds, 500 of sparrows, and the remainder distributed among other groups of economic value. A bulletin on

the food of sparrows has been published, one on the food of game birds is well advanced, and one including the results of an extended economic study of birds on a Maryland farm has gone to press.

For many years California fruit growers have complained of the destruction of buds and fruit by birds. In order to gain definite knowledge on this subject, the chief of the section was sent to California, where he spent several months studying the food habits of birds in the great fruit-growing districts. Besides observing the food habits and collecting the stomachs of birds killed in the fruit trees, he noted and collected the kinds of wild fruits and seeds, and also the insects found in the immediate neighborhood of the orchards, for aid in identifying the stomach contents of the birds.

Section of Game Protection and Preservation.

Work under the Lacey Act has been continued along three principal lines: (1) Publication of information on game protection; (2) improvement in the inspection service guarding the importation of foreign birds and mammals; (3) cooperation in restricting illegal interstate shipment of game.

Compilations and synopses of game laws have been issued and widely distributed, and are in constant demand. Among the most popular and useful of these are digests of the game laws and of the laws protecting nongame birds for the current year. An annual directory of State officials and organizations dealing with matters of game protection was also published.

During the year 287 permits were issued for the entry of about 200 mammals and 50,000 birds. The imported birds may be classed under two heads—game birds introduced for propagation and birds bought to supply the trade in cage birds. The latter greatly exceed the former in number. The inspection service, which now includes the principal ports of entry of both coasts, and also Honolulu, Hawaii, is now maintained by fees paid by the importers. Importers complain of this, and the Department would be glad to place the inspection service on a permanent basis should Congress make the necessary appropriation. By strict economy the service could be maintained at the three most important ports of entry at a total cost of $1,000 per annum.

DIVISION OF STATISTICS.

The work of the Division of Statistics has been continued on the usual lines. With a view to further improving its crop-reporting service two additional field agents have been appointed, and the statistical expert who has for some years had charge of the crop statistics of foreign countries competing with the United States has been sent to London, England, where he is in closer touch with the statistical offices of

the different European Governments, whose reports, along with the most authoritative commercial intelligence of interest to American agriculturists, he transmits to Washington by mail or cable from time to time.

In cooperation with the State Agricultural College of Minnesota a statistical investigation is being conducted by the Division of Statistics into methods of farming, the results of which will have an important bearing on such questions as the relative profitableness of crops, the economical utilization of farm labor, etc.

The work of this Division will shortly form the subject of a special report to Congress.

OFFICE OF EXPERIMENT STATIONS.

Development of the Work of the Office.

The functions of the Office of Experiment Stations have been enlarged in several directions during the past year, and the enterprises previously in its charge have become more extensive. Especial efforts have been made to aid the movement for the strengthening of agricultural education and research through the more definite formulation of agricultural science and the more thorough training of agricultural experts. For this purpose the work of this Office, in connection with the Graduate School of Agriculture, as described elsewhere in this report, has proved to be unusually successful and effective. Attempts have also been made to call the attention of the agricultural public and the managers of educational systems to the great desirability of making agricultural subjects a part of the curriculum of secondary and elementary schools. The development of the farmers' institutes as effective agencies for the dissemination of the results of the work of this Department and the experiment stations has also received attention. The agricultural experiment stations under the direct management of this Office in Alaska, Hawaii, and Porto Rico have been put upon a firm basis, and much progress has been made in developing useful lines of work in these regions.

The Office has been brought into closer relations with the institutions for agricultural research in foreign countries through work involved in the preparation of a bulletin setting forth the organization, resources, and lines of work of these institutions. By this means our knowledge of these foreign institutions has been greatly broadened, and it will be more feasible hereafter to secure definite information regarding their work which will be useful to similar institutions in this country. Both the legal and engineering features of the irrigation investigations have been enlarged, and a beginning has been made of investigations in other lines of agricultural engineering which have hitherto been neglected by this Department. Improvements

have been made in the apparatus and methods for nutrition investigations. The results of these investigations have been more effectively brought to the attention of teachers of physiology and domestic science, and beginnings have been made of what it is hoped may develop a systematic study of dietaries in public institutions.

With the expansion of its work the amount of useful material prepared for publication in this Office has materially increased. Special efforts have been made during the past year to publish this material in forms which will contribute to its effective and economical distribution. The performance of duties growing out of the relations of the Department with the Civil Service Commission has also involved considerable work. With the constant and rapid growth of the system of agricultural education and research in this and other countries the general business of the Office in its relations with outside institutions is necessarily enlarged from year to year.

Progress of the Experiment Stations.

The feature of the progress of agricultural institutions in this country which has attracted most attention during the past year is the rapid increase in the public interest in these institutions. This is shown in the increase in the number of students in agricultural colleges and schools, in the larger attendance at the farmers' institutes, in the enlarged correspondence and mailing lists of the stations, in the increased demand for trained workers in agricultural and other business enterprises requiring scientific and expert knowledge and skill for their most successful management, and in the wider space given to agricultural education and research in agricultural and other journals.

During the year a number of new institutions for investigations in agriculture have been established in different States. The State legislatures have continued to be very liberal with the agricultural colleges and experiment stations. Over half a million dollars annually are now contributed by the States to the maintenance of the experiment stations.

Evidences of the influence of station work in improving agricultural practice and benefiting the farming interests of the country continue to multiply. This influence is felt in all of the various phases of agricultural operations. It is possible here to briefly refer to only a few recent examples of the practical benefits which are being derived from investigations by the experiment stations.

The origination and introduction of improved varieties of cereals through the agency of the stations of the grain-growing region, cooperating with this Department, is resulting in a vast increase of the grain-producing capacity of the country. As an illustration of this it may be cited that a variety of oats imported by the Department and

tested and improved by the Wisconsin station, among others, has been widely distributed and grown, with results which indicate that its general introduction will be followed by an average increase of yield which may be safely estimated at from 3 to 5 bushels per acre. As the acreage of oats in Wisconsin alone in 1901 was, according to our statistician, 2,290,288, producing 66,647,381 bushels, worth $25,992,479, this would mean a gain to the farmers of Wisconsin annually of from $2,400,000 to $4,400,000 on the oat crop alone.

Marked improvement in the yield and quality of wheat in the Northwestern States is resulting from the distribution of improved varieties originated by the Minnesota station. One of the results of the work of the Illinois station on the breeding of corn has been the formation of the Illinois Seed Corn Breeders' Association, a chartered organization, with a limited membership of reputable and well-known corn growers, pledged to select and grow their seed corn according to definite rules formulated by the station and to sell only their own crop. The success of this enterprise has been phenomenal. All of the available supply of the improved seed is rapidly disposed of to farmers and much of it is engaged in advance. The work of this station on corn is proving to be far-reaching in its results, not only in improving the general quality of seed corn, but in inducing practical men to undertake breeding for special qualities—for protein, for oil, or for starch—which the station has demonstrated to be entirely feasible. The influence of station investigations is also being widely exerted in the grain-growing region in the introduction of rotations to conserve soil fertility in place of the exhaustive system of continuous grain cropping heretofore generally followed.

The beneficial effects of the work of the stations in the older States on fertilizers are becoming every year more apparent in the economical purchase and intelligent use of fertilizers by farmers. For example, as a direct result of the investigations and advice of the New Jersey station, organizations of farmers have been formed in the truck-growing districts of that State for the purchase of unmixed fertilizing materials, thus effecting a saving of from 25 to 40 per cent in the cost of their fertilizers, and at the same time securing better results as regards earliness, yield, and quality of product.

The recent introduction into a number of States of a system of inspection by the stations of feeding stuffs, similar to that which has been in force for some time for fertilizers, furnishes a very effective means of protecting farmers against fraud and of inculcating correct ideas regarding feeds and feeding. It is encouraging to note that in many States farmers are now following very closely the advice of the stations regarding the purchase of concentrated feeds and the balancing of rations made from home-grown products.

The rapid extension of the rational use of silage and the very

general adoption of the round form of silo is directly traceable to experiment station influence.

Through the efforts of the Department and the stations, the application of insecticides and fungicides as means of protection against injurious insects and plant diseases has become almost universal, and the benefits and profits resulting from the practice are no longer questioned. Striking evidence of the readiness with which farmers and fruit growers will now adopt promising means of plant protection is furnished by the fact that the method of formaldehyde treatment of smut of oats, proposed by one of the stations, was almost immediately put into use by over 25,000 farmers in the State of Wisconsin alone, with the prospect that the number using the method will be vastly increased the next year. As the estimated loss from oat smut in Wisconsin varies from $3,000,000 to $7,000,000 annually, according to the season and other conditions, the value of an effective means of prevention of the disease can be readily estimated.

The Utah station has achieved notable success in its study of the extent to which dry farming, that is, farming on lands in the arid region which can not be irrigated, may be practiced with profit and the conditions necessary to success. This work is bearing fruit in the rapid extension on a safe basis of what has heretofore been a very precarious system.

So rapidly has the demand for the services of agricultural experts spread in different directions that the workers in this service have in many instances been overworked, or, at least, have been forced to dissipate their energies in attempts to cover too many fields. There is, therefore, a most urgent necessity that the number of workers in our agricultural institutions should be increased so as to permit proper specialization of work. The station investigators must be relieved of teaching, lecturing at farmers' institutes, and other services, which, while important in themselves, distract their attention, dissipate their energies, and seriously hinder the progress of effective investigations.

It will be of little use to construct expensive laboratories and equip them with elaborate apparatus unless they are manned with first-class investigators. There is nothing new in this proposition, but the progress of agricultural institutions in this country in recent years makes it imperative that the work of the experiment stations and of this Department as the source of new knowledge on agricultural problems should be raised to the highest grade and kept there. The wider the work of the agricultural colleges, schools, farmers' institutes, and other agencies for the education of our rural population becomes the more important is it that the institutions of research in agriculture should be the best that human wisdom can devise. It is now necessary to insist on this more strongly than ever before, and it will be necessary to reiterate it until the managers of agricultural institutions and

the friends of agricultural progress accept this principle in practice as well as in theory. Under present conditions a large number of the experiment-station workers are attempting too many different kinds of work, and the progress of the station is seriously hindered from this cause.

One result of the lack of a sufficient number of well-trained and experienced workers in our agricultural institutions is that the best men are constantly being shifted from one institution to another or are departing to outside enterprises offering larger salaries and other attractions. The past year has witnessed an unusually large number of such changes in the personnel of the experiment stations. This is a very serious matter, since the time element in the conduct of agricultural investigations is an important one. Until the tenure of office in our stations is much more stable than at present we must expect that there will be much waste of work and funds in incomplete investigations due to the frequent shifting of the officers in charge. There is also need of increased funds for the general expenses connected with agricultural investigations.

Cooperation of the Stations with the Department.

During the past year many cooperative enterprises between the different Bureaus and Divisions of this Department and the experiment stations have been continued and contracts have been made for a considerable number of new investigations on this plan. In order to more clearly define the conditions under which such cooperative arrangements should be made a plan was formulated for conducting this work and transmitted to the directors of stations as well as to the chiefs of Bureaus and Divisions of the Department. This has cleared away some difficulties hitherto attending arrangements with the stations, and especially has defined the responsibilities of both the Department and stations in such enterprises.

The work undertaken conjointly with the stations is of the most varied character, but under the system devised there is no friction, and it is believed that much good will result to both the Department and the stations by this close union of interests. In all cases the general policy is to bring about a definite and clear understanding regarding the responsibilities of the Department and the stations, and when this is accomplished the carrying out of the details is a comparatively simple matter. The Department is not concerned with local State problems, but there are questions not bounded by State lines which the Department can take up, and which, with the cooperation of one or more stations, should be earnestly investigated. In this way the Department becomes the medium for the combining of interests in a way that will be helpful to all.

Graduate School of Agriculture.

A new enterprise in agricultural education has been inaugurated by the establishment of the Graduate School of Agriculture, which held a four weeks' session during the month of July, 1902, at the Ohio State University, Columbus, Ohio. The plan for this school was originated by Prof. Thomas F. Hunt, dean of the college of agriculture and domestic science of the Ohio State University, the purpose being to establish a school for advanced students of agriculture at which leading teachers and investigators of the agricultural colleges and experiment stations and this Department should present in some regular way summaries of the recent progress of agricultural science, illustrate improved methods of teaching agricultural subjects, and afford a somewhat extended opportunity for the discussion of live topics drawn from the rapidly advancing science of agriculture. This idea received the cordial support of President Thompson of the Ohio State University, and on the recommendations of these two men the board of trustees of the university voted to establish such a school and generously made provision for the financial support of its first session.

The Association of American Agricultural Colleges and Experiment Stations at its convention in 1901 favored the plan for the school and voted that, if the success of the first session seemed to justify its continuance, it be made a cooperative enterprise under the control of the association. Believing this movement to be in line with the objects for which this Department was created, I gave it my cordial approval, and on my advice the Director of the Office of Experiment Stations consented to act as dean, and other officers of the Department of Agriculture to be members of its faculty. Under these favorable auspices there was little difficulty in securing a strong faculty. As actually organized, this included 35 men, of whom 26 are professors in agricultural colleges, 7 are leading officers of the Department of Agriculture, and 2 are officers of the New York State experiment station. Courses were offered in agronomy, zootechny, dairying, and breeding of plants and animals. The school was housed in the substantial and well-equipped agricultural building of the Ohio State University, where were illustrated the most improved apparatus of instruction in soil physics, dairying, and other agricultural subjects. Besides the live stock of the university farm, leading breeders of Ohio furnished choice animals for the stock-judging exercises.

General problems of agricultural science and pedagogy were discussed at the inaugural exercises and at Saturday morning conferences. Among the topics thus treated were the history of agricultural education and research in the United States; the organization of agricultural education in colleges, secondary schools, nature-study courses, correspondence courses, farmers' institutes, and various forms of

university extension; what constitutes a science of agriculture; methods and values of cooperative experiments. Through social assemblies, visits to typical Ohio farms, and much informal discussion wherever the students met each other, the educational influences of the school were greatly extended. Seventy-five students were in attendance. These were drawn from 28 States and Territories, including such widely separated regions as Maine, Oregon, California, New Mexico, and Alabama. There was one student from Canada and one from Argentina. There was also one woman, and the colored race was represented by teachers from the Tuskegee Institute and the agricultural college at Greensboro, N. C. Twenty-seven of the students are professors or assistant professors of agriculture in agricultural colleges, 31 are assistants in the agricultural colleges and experiment stations, 9 are recent college graduates, and 8 are engaged in farming.

Considering the character of the faculty and students, it goes without saying that the whole period of the session was occupied with the most earnest and profitable work. Without doubt the influence of this school will be felt throughout the country in the improvement of courses of instruction in agriculture and the strengthening of the lines and methods of investigation of agricultural subjects. In other ways the school will exert a beneficial influence. So rapid has been the accumulation of materials for a real science of agriculture during the past few years that even professional students of agriculture have not realized how large a mass of knowledge is already available for molding into a systematic body of truth which may be utilized for pedagogic purposes, as well as for inductions of scientific and practical value. The summaries given by the experts gathered at this graduate school have emphasized this fact and shown in a striking manner that agricultural education and research may now be properly and efficiently organized with reference to the science of agriculture itself, rather than be as heretofore very largely a matter of the sciences related to agriculture. This will serve to stimulate greatly the movement already begun for the reduction of the materials of agricultural science to "pedagogic form" for use in colleges and secondary schools, and for the reorganization of agricultural institutions of research on the basis of the divisions and subdivisions of agriculture instead of physics, chemistry, botany, and other primary and secondary sciences. The day will thus be hastened when the science of agriculture will rank as one of the great systems of knowledge of direct benefit to mankind.

Improvement of Rural Schools.

We are, without doubt, in this country just on the edge of a great popular movement for the improvement of the conditions of rural life through the improvement of the rural schools. As one phase of this movement there will come the broadening of the instruction in the

principles of agriculture, so that in addition to college courses we shall have secondary courses in ordinary and special high schools, and even some elementary instruction in the common schools. In establishing the lines and methods of secondary and elementary instruction in agriculture so that it may be useful and attractive to the masses of our rural youth, the leaders in agricultural science gathered in the Graduate School of Agriculture this summer will play an important part, and it is believed that they have gone out from this school with much inspiration to renewed efforts in this direction. For both the thorough establishment of the science of agriculture and the wide popularization of this science, the new school will, it is believed, be an efficient agency, and I hope the way may open for it to become a permanent institution.

The Agricultural Colleges.

A number of the agricultural colleges have made considerable progress during the past year in strengthening and broadening their courses in agriculture. Specialists in agronomy, animal husbandry, soil physics, soil bacteriology, dairying, and other branches of the general subject of agriculture have been added to their faculties. This has made it possible to materially increase the number of different courses in agricultural subjects offered to their students. This is especially true of the short or special courses in agriculture for students who for one reason or another are not able to take the entire course leading to the bachelor's degree.

Statistics of attendance at the land-grant colleges for the year 1901 show that over 42,000 students were enrolled. This was an increase of nearly 7 per cent over the attendance for the previous year. The total attendance upon four-year courses in agriculture (including dairying) increased more than 26 per cent. The number of students in special courses has fallen off relatively, indicating a growing recognition of the greater value of the full collegiate course in agriculture as compared with specialization along narrow lines in undergraduate work.

During the past two years there has been a remarkable increase in the number of buildings erected at these colleges. It is estimated that during this period at least $2,000,000 have been spent by the States for this purpose. In these buildings there are not only improved facilities for instruction in the sciences related to agriculture, but also more particularly for the teaching of the different branches of the science of agriculture itself. The changes in equipment and in the organization of faculties have put college instruction in agriculture largely on a new basis. Since the new courses deal much more largely directly with agriculture, both as an art and a science, the students are not only well trained in the theory of agriculture, but are brought

much more closely into sympathy and actual contact with the practice of the art. Each year the chasm which formerly existed between science and practice is being more strongly bridged. Stronger bonds of sympathy and effort are uniting scientists and farmers through the medium of the agricultural institutions. The colleges therefore not only occupy a better position in the educational world, but they are also more strongly intrenched in the confidence and support of the great masses of practical men.

Secondary and Elementary Schools of Agriculture.

Institutions for secondary and elementary instruction in agriculture are becoming more numerous. Schools of this class already established have been continued, new schools are being established, and courses of instruction in agriculture, nature study, and gardening are being introduced into existing public and private schools. The marked success of the agricultural high schools established in connection with the universities of Minnesota and Nebraska indicates that there is a demand for agricultural courses of parallel degree with those offered in various manual arts in our city high schools. Already there is a promising movement for the establishment of special agricultural high schools in different localities separate from the colleges, and some instruction in agriculture is now given in a number of normal and public high schools. Students taking such high-school courses would undoubtedly be able to better appreciate the work of this Department and the agricultural experiment stations and would have a better outlook regarding the movements of our times for the improvement of agriculture, which would enable them to become intelligent, progressive, and successful farmers. All over our country farmers are sending their children to public high schools and paying tuition for their instruction. They have, therefore, good reason to urge that courses on subjects related to agriculture should be introduced into these schools, especially in towns which are wholly or largely dependent on the neighboring farms for their commercial success, if not their very existence.

Since the funds expended in promoting technical education in agriculture are in the nature of investments which will be richly repaid in larger amounts of assessable farm property and the increased wealth that comes from improved farm products, both the States and the local communities can well afford to make liberal contributions to the support of courses in agriculture in the secondary schools as well as in the agricultural colleges.

Progress is also being made in the movement for the consolidation of rural schools which has already resulted in improved conditions in the schools of Ohio, Massachusetts, Iowa, and other States. Such consolidation makes it possible to introduce nature study in which matters pertaining to agriculture, horticulture, and domestic arts are

easily included. Several States have already passed laws requiring teachers to prepare themselves to give instruction in nature study and agriculture, and exercises and illustrative material for such work are being more frequently published, often with the aid of the teachers in the agricultural colleges.

Another closely allied movement at present manifest principally in the city schools is the school-garden movement—the introduction of garden work with flowers and vegetables into the graded schools as a weekly or semiweekly exercise. Wherever work of this kind has been tried under proper supervision it has aroused considerable interest on the part of the students, has furnished excellent material for nature-study work, and has correlated well with the other studies in the curriculum.

Farmers' Institutes.

In my last annual report I recommended that an appropriation of $5,000 be given to enable the Office of Experiment Stations to undertake work connected with the promotion of the farmers' institute system in this country. The appropriation was to be used in employing an officer who would devote his time and energy to this work, visit institute workers and advise them regarding the ways in which the Department might help the institutes, study the problems of institute management at home and abroad, and seek to shape the Department's work for the institutes so that it might be most helpful to this enterprise. As the matter was finally fixed in the appropriation act, only about $2,000 of the income of the Office of Experiment Stations for the current fiscal year can be used for this purpose. This is entirely inadequate for the work planned, but will be used in gathering statistics of the institute movement and in employing, during a part of the year, an officer who will be retained as farmers' institute specialist, if Congress shall provide sufficient means for continuing the work.

Farmers' institutes are now held in 44 States and Territories, including Hawaii. Nearly complete returns from 40 States and Territories show that in the areas reported about 2,300 institutes are held annually; that the funds expended by the different States and Territories in support of these institutes (not including expenses incurred by local authorities) amounted to about $196,000 per annum, and that about 709,000 people attended the institutes. The number of students taking the agricultural course at the agricultural colleges in the same States and Territories during the year ended June 30, 1901, was 9,623, including those who are recorded as attending courses in household economy, dairying, and veterinary science.

The total number of persons reached by the farmers' institutes and the agricultural colleges (about 720,000) is, however, only a small percentage (7.2 per cent) of those actually engaged in agricultural pur-

suits (about 10,000,000). The publications of the experiment stations are sent to about 500,000 farmers. A great need of our educational system is, therefore, wider dissemination of the results of agricultural study and research among those now actually engaged in farming.

I recommend that an appropriation of $6,000 be made by Congress to enable the Office of Experiment Stations to aid the farmers' institutes during the fiscal year 1904.

Experiment Stations in Alaska.

Agricultural experiment stations were maintained during the fiscal year 1902 at Sitka, Kenai, and Rampart. The experimental work has included the growing of cereals and vegetables, methods of reclamation, drainage, and fertilization of land, and the curing and ensiling of forage crops. In all these lines successful results were obtained, and much information which will be of use to persons attempting agriculture in Alaska was acquired. The survey of different portions of Alaska with reference to their agricultural possibilities was continued. The special agent in charge made a journey through a large portion of the Yukon River Valley. A reconnoissance of the Copper River regions and portions of the Fortymile country and the Tanana River Valley was made during September, 1901, by the assistant who had been in charge of the station work at Rampart. He estimated that in the region covered by his journey there was some 2,000,000 acres of land suitable for farming and pasture. Grass grew abundantly and luxuriantly in large regions.

The distribution of seed of hardy varieties of vegetables, cereals, and grasses has been continued and extended, seed for use the present season having been sent to some 750 addresses. Many reports of trials of seed previously sent have been received, and in this way much useful information has been secured. It is evident that the efforts made by the Department to aid the residents of Alaska in their agricultural work by distributing improved varieties of seeds have produced beneficial results. Not only has this been of advantage to the white population, but the natives also are learning to cultivate gardens, and it is reliably reported that there is a large increase in the number of natives who attempt to cultivate small patches of ground.

The equipment of the stations in Alaska has been increased by the erection of a barn, cottage, and small blacksmith shop at Sitka and the completion of a small station building at Kenai. During the present year a beginning will be made of establishing a nursery of hardy fruits at Sitka. Only a limited amount of work in this line can be done until a horticulturist is added to the station staff. It is also planned to secure a small flock of Angora goats, with a view to ascertaining whether these animals can be successfully reared in the coast region of southern Alaska. The plants naturally growing in this

region will furnish abundant forage for goats. The work at Kenai will be continued and similar operations will be carried on at Rampart and Wood Island and in the Copper River region.

It is hoped to complete the headquarters building at Sitka during the present year. The cost of this work will be about $2,000. As soon as possible a small herd of cattle should be placed at the Kenai station and experimental work in animal husbandry begun. This would involve the building of a barn there and the employment of additional laborers. The station at Sitka should have an equipment of chemical apparatus sufficient for simple chemical work.

As long as the income of the stations is on the present basis it will not be possible to do more than maintain the stations at Sitka and Kenai and do a very limited amount of work at one or two places in the interior.

Hawaii Experiment Station.

A large amount of work has been done at the Hawaii experiment station during the past year in clearing and preparing for cultivation portions of the tract reserved for the station and establishing plantations of fruit and other valuable trees and experimental plats. The buildings begun the previous year were completed, and the station now possesses a residence for the special agent in charge, an office and laboratory, stable, cottages for laborers, water tanks, etc.

Experiments have been begun with potatoes and taro to overcome the very destructive diseases which seem to threaten the extinction of these crops. Taro forms the principal food of the Hawaiians, and the ravages of the blight have so curtailed the supply that there has been actual suffering in some places because of the shortage. At present the experiments are being confined to the lowland taro, and an effort is being made to find some remedy for the disease that attacks the root. Dry-land taro does not appear to be as susceptible to disease, but it will be studied also. It was found in many cases that immature and diseased cuttings were used for planting. The lowland form of taro requires extensive irrigation, and in practice the land is kept flooded for a considerable time. Wherever the water was allowed to become stagnant it was found that the root rot was most prevalent. By the use of fertilizers it was found possible to actively stimulate the growth of the plant and make it less liable to disease. Wherever a liberal application of lime was made there was no disease, and with care in the management of the water, selection of cuttings, rotation of crops, use of lime and fertilizers it was found possible to not only reduce the disease, but to considerably increase the production of the crop.

The experiments with potatoes were conducted upon the island of Maui in cooperation with one of the residents of that island. This island formerly produced the most of the potatoes grown in the archi-

pelago. A disease locally known as black rot has for ten or more years been seriously depreciating the crop. This, as has been determined by the station authorities, is due to a soil fungus, and experiments are being undertaken to combat it. In the field investigations 45 varieties of potatoes were grown under similar conditions, and marked differences were noted in the susceptibility of the varieties to disease. This work is to be followed up in the hope that some sorts may be found which are nearly or quite resistant to disease.

Investigations were begun on the diseases of poultry, and a bulletin was issued in which suggestions were given for the care of fowls and treatment of the diseases to which they are especially subject, and as a result of which poultry and eggs are excessively expensive in the Hawaiian markets.

Attention has also been given to fiber plants, mangoes, the castor bean, pineapples, peppers, and rubber and cork oak trees, and other plants believed worthy of investigation and development. A study has also been made regarding the use of pumps for irrigation purposes in the Hawaiian Islands, where the pumping of water for this purpose has in all probability reached its highest development. Members of the station staff have visited other islands of the group and an attempt has been made to get into touch with all the agricultural communities. Farmers' institutes are being organized under the auspices of the station. Bulletins on chickens and their diseases and on taro have been prepared and others are in course of preparation. It is clear that there is a wide field for agricultural investigations in this Territory. Owing to local conditions of soil, temperature, rainfall, and other natural conditions, the station will be obliged to do much work in different localities.

The presence of enormous numbers of destructive insects is one of the chief obstacles to agriculture in Hawaii. The land areas are small and the uniformity of seasonal temperatures presents no check to the development of insects which may have been introduced from continental regions. As a result the insects speedily lose their distinctive habits. Many of the introduced species no longer have a definite life period, but breed at all seasons and are practically in continuous existence throughout the year, swarm following swarm, with no intervening period when the land is free from their ravages.

There are a number of serious fungous diseases of plants which require investigation, both because of the local losses caused by them and on account of the possibility of their being carried to other parts of the islands. The work on the taro rot and the Fusarium disease of the potato will need to be continued for several years.

There are many problems of both scientific and practical interest which require the services of a chemist. Soil and water analyses, the study of the rôle of mineral nutrients in plants and soils, the composi-

tion of Hawaiian foods and feeding material all should be given attention. Investigations should be made as the occasion requires of other agricultural products which may lead to the establishment of local industries, such as fiber plants, tans, dyestuffs, rubber, vanilla, coffee, tobacco, silk, fruits, and vegetables.

Considering the numerous agricultural problems requiring investigation in the Territory of Hawaii, the experiment station there should have added to the station force a chemist; the apparatus and other equipment should also be increased, and provision made for the printing and distribution of station publications.

Porto Rico Experiment Station.

The agricultural experiment station in Porto Rico is now established on a permanent basis. This result has been secured through the cooperation of the insular government and legislature. A bill appropriating $15,000 for the purchase of a suitable tract of land for the station was passed in February, 1902. Under this law bids were called for which were closed the 12th of May. The result of these negotiations was the purchase of approximately 230 acres of land adjacent to the city of Mayaguez. The land is varied in character and well located with reference to the city. It gives promise of making a very desirable site on which to carry out the objects of the experiment station.

On this tract it is proposed to begin field tests of leguminous crops, grasses, corn, rice, beans, and vegetables. A nursery and orchard of tropical fruits, including those grown on the island, and promising varieties from other countries will be established for experimental purposes. With the temporary experiments undertaken last year much useful information has been obtained regarding soil and climatic conditions as related to the growth of crops in the island. An important study has also been made of the Changa, a mole cricket, which is the most injurious insect of the island, and a bulletin regarding this insect will soon be published in both Spanish and English for distribution in Porto Rico. Experiments looking toward the improvement of coffee, now grown so largely in the island, have already been well begun, and it is proposed to extend them materially during the coming year.

It is important that the Porto Rico station should undertake experiments with live stock, but it will not be possible to do much in this direction unless the resources of the station are increased. Additional funds will be required for the employment of a competent live-stock expert, the purchase of animals, and the general expenses of feeding experiments. In order to effectively conduct experiments with fruits a horticulturist should be added to the station staff.

Now that the Porto Rico station is permanently located, it should, in my judgment, receive the same financial support from the National Treasury as is given to the stations organized under the act of Con-

gress of March 2, 1887. Considering the large population to be maintained by agriculture in Porto Rico, every effort should be made to develop the agricultural resources of the island. The station will be called upon to aid in the solution of a great variety of problems. The range and effectiveness of its work will necessarily be limited by the funds at its command. When the nation does as much for the Porto Rico station as for stations in the other States and Territories, there will still be need for additional financial assistance from the insular government. The cordial support which has been given the station by the Government and the substantial grant of money voted by the insular legislature for the purchase of land for the station have given evidence that the people and government of Porto Rico appreciate the importance of this enterprise and are willing to supplement the efforts of the National Government in this direction. As the work of the station develops, additional buildings and equipment will be needed, and it is confidently expected that these requirements will be met by the local legislature.

Nutrition Investigations.

The nutrition investigations have been continued along the same lines as heretofore, including dietary studies, and digestion, cooking, and metabolism experiments. These studies have been carried on in cooperation with universities and experiment stations in Maine, Massachusetts, Connecticut, New York, Tennessee, Illinois, California, Minnesota, Vermont, and Georgia. The respiration calorimeter used in these investigations has been improved, and the studies during the past year with this apparatus have had reference especially to the relative efficiency of fats and carbohydrates as sources of energy for the performance of muscular work. To further study the relation of diet to muscular work, dietary studies with lumbermen performing severe work in the forests of Maine have been made. Among other subjects of investigation have been the digestibility and nutritive value of bread made from different kinds of flour; the effect of cooking on the nutritive value and digestibility of different kinds and cuts of meat; the relative nutritive value of different kinds and combinations of fruits and nuts, and the comparative metabolism of nitrogen, sulphur, and phosphorus. Five bulletins regarding the results of nutrition investigations were published during the past year. Special efforts have been continued to bring the results of this work to the attention of schools and colleges, physicians, scientists, superintendents of public institutions, persons engaged in philanthropic enterprises, etc.

At the summer school of nutrition and bacteriology, held at Wesleyan University, Middletown, Conn., in July, 1902, under the direction of the special agent in charge of nutrition investigations in connection with his work as professor in that institution, the methods and

results of the nutrition investigations of this Department were explained to a considerable number of teachers of domestic science from different regions, and others who have engaged to a greater or less extent in the teaching of nutrition, bacteriology, and kindred subjects in the agricultural colleges and other institutions.

As stated in my previous report, it is very desirable to extend the nutrition investigations through a systematic study of dietaries in public institutions. Plans for beginning this work have already been made and considerable material, including summaries of results of early investigations, has been collected. Through an arrangement with Dr. A. B. Richardson, superintendent of the Government Hospital for the Insane in the District of Columbia, dietary studies will be made in that institution during the current year in accordance with plans furnished by this Office.

In early times the idea was prevalent that the diet of prisoners and other delinquent classes should be so poor and inadequate that it constituted a punitive measure. This is now recognized as wrong, and most civilized nations endeavor to feed such persons adequately. The food requirements obviously vary with the amount of work performed, and in most cases it is essential that the cost of the food be moderate. Food investigations are required in prisons and other institutions in order that satisfactory dietary standards may be formulated, and also to compare the rations actually fed with proposed standards. The importance of such studies has been often recognized in the past; for instance, under the authority of the institutions' commissioner in Boston, Mass., dietary investigations were carried on in a number of reformatories, etc., in that city. Studies have also been made at the reformatory at Elmira, N. Y., some of which had the special object of determining whether it was possible to favorably affect the moral welfare of inmates through their diet.

Under special government authority the diet in Scotch prisons has been recently studied, and mention may also be made of recent work of a similar nature in Berlin. In many cases it has been found that it is possible to furnish a more satisfactory diet and at the same time diminish the cost.

Nutrition investigations have also been made in almshouses, orphan asylums, and similar charitable institutions in times past in this and other countries—Germany having taken the lead. The importance of providing a proper diet for inmates of such institutions has received government recognition in Great Britain, and investigations bearing on the subject have been undertaken there. An adequate diet should unquestionably be supplied to all who are dependent on charity of this sort. The numerous studies which have been made show that with proper care good food may be provided at a reasonable cost. While the diet in many institutions is undoubtedly satisfactory as regards

kind and cost, it is not too much to say that in very many others dietary studies would show the possibility of diminishing the cost and at the same time improving the quality. The benefit to the inmates and saving of public money in this way seem worthy of all possible effort.

In previous reports I have called attention to the fact that investigations were needed to determine the food habits and requirements of residents of tropical countries. This matter is becoming of increasing importance, owing to the continuance of soldiers, sailors, and civil officers of the United States in such regions. This, and the fact that large numbers of our people are called to tropical regions by our rapidly extending commerce, would seem to justify the institution of such investigations to determine the most suitable diet under the new climatic conditions. It is well known that a suitable diet is a matter which has a great effect upon the maintenance of good health of old residents in tropical countries, and is even more important for recent arrivals. The U. S. Army has devoted considerable attention to this subject, as have also German, British, and other European investigators, generally under the auspices of the army or navy of their respective Governments. The lack of agreement regarding the diet best suited to residents of the Tropics shows that more extended investigations are required.

The economic feeding of troops and other residents in tropical regions obviously depends in some measure upon the utilization of local food products. Many of these products are comparatively unknown outside the Tropics, and their food value has never been studied.

Irrigation Investigations.

Two causes have operated during the past year to increase the interest in the Department's work for irrigated agriculture. One was the desire of the arid States for the creation of conditions which will result in the largest and best use of the water supply, and the other the drought which prevailed throughout the Middle West in 1901 and in the South during 1901 and the present year. As a result of this interest, requests for information and advice have been far more numerous than ever before, and it is only through the increased appropriation made by the last Congress and the better organization of the work that these demands have been met.

The distribution and use of Western rivers require that the irrigation industry shall be organized, and in order to provide for this it is necessary that there be a better understanding of the subject than now exists. The first need is for the facts. We need to know how much water is being used, where it is being used, how much water is required for the maturing of crops, how it can be distributed with the least loss, and how applied to the best advantage. This information

the Department is securing and disseminating through this investigation, and in doing this it has enlisted in its service many of the leading irrigation engineers and scientists of the arid States. The services of these men would have involved a prohibitory expense if it had been necessary to employ them continuously, but through cooperative arrangements with the State agricultural colleges and experiment stations and the State engineers' offices the scope of both local and national investigations has been broadened and made more effective, while the outlay to each of the parties to these arrangements has been greatly reduced.

THE DISTRIBUTION AND USE OF WATER.

The Department is now making measurements of the water used in irrigation in all of the arid States but one and in a number of humid States. The results of these studies during the past three years, while not conclusive, have already done much to educate farmers and ditch managers as to the direction from which improvements of methods and practices must come. They have made plain the need of better work in constructing and maintaining canals. They have shown that the water lost through leakage in transit is far greater than has been generally supposed, and that its loss causes a double injury. It returns in many instances to the surface of lower-lying fields and converts productive areas into unsightly swamps and marshes, rendering them for the time practically worthless. The loss of water through evaporation from these submerged areas is large. If this could be prevented and the water saved applied to crops it would largely increase the cultivated area. One of the leading lines of work of these investigations will therefore be a more careful study of losses from seepage, in order to determine measures by which this can be lessened.

In a number of instances these studies have led to careful inquiries by canal owners to determine whether or not it will be profitable to cement the main ditches and canals, and to requests for further assistance from this investigation to determine how this may be done to the best advantage. The Report of Irrigation Investigations for 1901 will give the methods pursued and the cost of cementing one of the principal canals of southern California.

DRAINAGE SURVEYS.

In response to numerously signed petitions from the agricultural and horticultural interests of the valley of Kings River, in California, the Department has carried on a comprehensive drainage survey to determine what plans can be best adopted for relief of the overwatered lands of that section. This work has been under the direction of Prof. O. V. P. Stout, of the University of Nebraska, and the report, which is now approaching completion, will give the plans and estimates for

two methods of removing the surplus water and making it available for use elsewhere. The carrying out of these plans will probably require additional legislation on the part of the State, and a local committee has been formed to frame bills and promote the enactment of needed laws.

At the request of the Hon. A. J. McCune, State engineer of Colorado, the Department has assisted in the investigation of the drainage problems of that State. This work is under the direction of C. G. Elliott, a drainage engineer of wide experience. The information already gained makes it certain that these studies are to be worth many times their cost, both to the localities where they have been carried on and in their influence on the larger and better use of the water supply. Some fears have been expressed that the water coming from these drains would be unfit for use because of the large percentage of alkali it contained, but analyses made by the State experiment stations of Colorado and California have shown that this is not the case.

STUDIES OF IRRIGATION LAWS.

The larger problems which the complete use of Western rivers is destined to create and the measure of public control which recent irrigation legislation renders inevitable gives added interest to the Department's studies of the legal and economic phases of irrigation. The division of the water of streams among farms scattered for hundreds of miles along their courses, so that each acre cultivated shall receive its just share of the common water supply, is one of the most complex administrative problems which confronts Western agriculture, and the establishment of titles to these streams by methods which shall prevent speculative appropriations of water and the creation of water monopolies is one of the imperative needs of the immediate future.

The larger opportunities which national aid affords should awaken the civic pride of the States benefited in seeing to it that not only in material development but in their institutions the irrigation systems of this country rank among the foremost of the world.

A beginning of the studies of the conditions and experiences of other lands was made during the past year. Mr. C. T. Johnston, assistant chief of these investigations, visited Egypt for this purpose. Through the courtesy of Government officials he was enabled to become fully acquainted with the administration of the laws which govern the use of the Nile, and his report will show the character of the rights to water recognized and the manner in which these rights are enforced in times of scarcity. While differences in conditions will doubtless prevent the adoption of many of the methods pursued, the lesson of one of the oldest irrigated countries in the world can not fail to be of great interest and value to one of the youngest. In addition, Mr.

Johnston's report will present many matters of practical information regarding the size and construction of canals, the manner in which water is distributed and applied to crops, and the yield and value of the products.

A number of the arid States are cooperating with the Department in these studies of sociological and legal problems. Montana and Nevada appropriated money for such studies, and the irrigation officials of Wyoming, Colorado, and Idaho have given both personal and official aid. No branch of the Department's irrigation work has received more cordial recognition than its studies of legal and sociological questions, and it is believed that they are destined to exert a beneficent influence on the future industrial life of the West.

IRRIGATION IN THE HUMID STATES.

The development of the rice industry in Louisiana and Texas has had the effect of enormously increasing the value of land hitherto used only for grazing purposes or not at all. Its success has led to the investment of large sums of money and a marked increase in the population. In the amount of money invested in canals and pumping plants and in the increase in the acreage reclaimed, the rice districts of Louisiana and Texas have made as great progress during the past two or three years as any of the irrigated districts of the West. This rapid growth has given rise to a number of practical problems in which the aid of the Department has been invoked.

Establishing and maintaining pumping plants requires a knowledge of the amount of water required, the cost of furnishing it, and the methods by which waste in use may be reduced to the minimum. The light rainfall of the past two seasons has also made it manifest that the time is not far distant when there will be need for establishing rights to the use of streams and some division of their water supply among these irrigators. During the present season the rainfall from June to September was little more than that of many of the arid States, and this, combined with the large increase in the irrigated acreage, has made the drain on some streams cause their current to be reversed and salt water to flow in from the Gulf.

The growth of irrigation in the Southern States is not, however, confined to the rice districts. During the past year the experts of this investigation have furnished information and advice to farmers in Georgia, Alabama, and the Carolinas under which a number of irrigation systems have been installed. The drought of the present season has made the first year's trial a marked success, but it will require a number of years to determine to what extent irrigation can be profitably employed in this section. The fact that the Department was able to answer these inquiries has saved large sums of money to individual farmers. In nearly every instance they had planned to put in pumps

of too small capacity to have been of any real service, and the attempts would have resulted in disappointment and loss and probably have delayed adoption of what promises to be an important aid to both agriculture and horticulture.

The cooperative irrigation studies undertaken in connection with the State experiment stations of Wisconsin, Missouri, and New Jersey have been continued, the object being to determine how far and by what method irrigation can be profitably employed in the humid States.

In view of the increased interest in the questions with which the irrigation investigations of this Department deal, growing out of the rapid development of our irrigation system under private as well as public auspices, there is constantly enlarging demand for the services of our irrigation experts and for the published results of their investigations.

Agricultural Engineering.

In order to answer the inquiries received by the Department and to make the irrigation investigations of the greatest practical benefit, it has been necessary to include studies of the applications of power whose relation to irrigation is made apparent only by a thorough understanding of existing conditions. Farmers under irrigation apply to the Department for information regarding the use of streams and canals for power purposes. Many who desire to irrigate small tracts apply to the Department for information as to whether or not pumping will pay, the kind of pumps to be used, and the amount of water required. Inquiries are received as to the relative economy of different forms of power, and whether coal, oil, gas, electricity, or wind power will best serve the irrigator's purposes. These questions should be answered because nothing is more wasteful than to have each man learn experimentally for himself what has been found out elsewhere, but the attempt to do this has made agricultural engineering an important feature of these investigations, and raises the question whether the usefulness of the work of this Department can not be materially augmented by entering upon a systematic study of agricultural engineering as related to the interests of all our farmers.

The possibilities of this subject can be illustrated by the one item of farm machinery. In the past twenty years the capital invested in the manufacture of agricultural implements has increased from sixty to one hundred and fifty-seven millions, and the value of the product has more than doubled, but more significant than this increase in its importance have been the changes in its character. Leaving out of consideration the larger and more important classes of farm machinery, such as reapers, mowers, and thrashers, which are usually thought of as supporting the claim that American inventive genius and mechanical skill have surpassed the world in constructing farm machinery, and taking

up machines and implements but little thought of in this connection, it will be seen that the changes wrought in the past twenty years have been little less than revolutionary, and have been an important factor in maintaining our commercial supremacy. The invention of the disk harrow to supplement the types formerly used, the invention of the disk plow to compete with the types in use for centuries, the still more recent invention of corn-harvesting machinery, all serve to show the rapidity and radical character of the evolution which is now going on.

These facts, in connection with the increasing demand for efficient labor-saving devices resulting from the growing scarcity of farm labor and the organization and development in foreign countries of institutions for the systematic study and improvement of farm machinery, renders it important that we should not longer neglect this field of inquiry. There is an excellent opportunity for the Department to do an important service in promoting the continuance of our agricultural supremacy through the use of farm machinery by investigations regarding the fundamental principles on which the further improvement of such machinery must depend.

At present the Department is not in a position to answer the numerous requests for information on these subjects, and these demands will undoubtedly increase with the growing application of new forms of power to farm work and the development of new kinds of labor-saving machinery. The agricultural colleges and experiment stations throughout the country are beginning to realize the need of such studies, but they find great difficulty in establishing the work on an efficient basis owing to the lack of definite information in available form. It is believed that this Department should undertake to collate and publish such information, as well as to institute investigations which will keep the farmers and manufacturers of the country informed of the progress being made and show them the lines in which it may be extended.

Investigations in agricultural engineering should also include problems relating to the laying out of farms, such as the arrangement of buildings, drains, water supply, and disposal of sewage. The character of the agriculture of the twentieth century has made farm buildings as complex in design and varied in use as factories, and there is a wide field of study for improvement in design and for determination of the best material to be used in their construction.

The breeders of high-bred and valuable live stock need to give almost as much attention to stable sanitation as is given to house sanitation, but the data on which to plan efficient systems of ventilation are of the most limited character. It is believed that careful studies of the designing of farm buildings will be a benefit to agriculture, not only in saving large sums of money in the selection and combination of material used, but in the adoption of more convenient and effective plans.

Need of Adequate Funds.

This review of the work of the Office of Experiment Stations in all its phases shows very conclusively the necessity for more liberal appropriations, as submitted in my estimates for the ensuing year, for carrying on the several lines of work assigned to the Office of Experiment Stations. It is particularly desirable that the stations in Alaska, in Hawaii, and in Porto Rico, which are under the direct supervision of the Secretary of Agriculture, should be as liberally dealt with in this respect as are the stations in the several States and Territories of the Union.

DIVISION OF FOREIGN MARKETS.

Investigations made by the Division of Foreign Markets regarding the status of our agricultural export trade in the principal markets of the world disclose an exceptional activity on the part of some of our most formidable competitors for that trade, and particularly such countries as Australia, Canada, and Argentina. These progressive exporting countries have within the last few years been taking exceedingly active measures for the extension of their foreign business. As was pointed out in a publication recently issued by the Division on the subject of the British agricultural import trade, about two-thirds of the farm produce required by the British people to supplement their domestic supply is now being purchased from the various competitors of the United States. The success of these competing countries suggests the importance of constant watchfulness in the interests of our own export business.

Agricultural Exports in 1902.

Statistics recently prepared by this Division show that the agricultural exports of the United States for the fiscal year 1902 had a value of about $860,000,000. In comparison with the record-breaking figures of the preceding year, the value for 1902 exhibits a rather marked decline. Next to the exceptional record for 1901, however, it is the largest ever reported, being decidedly above the average of the decade.

The decline from the high mark reached by our agricultural exports in 1901 was principally due to the fact that a serious shortage in the corn crop left a comparatively small supply of this important export grain available for shipment to foreign markets. Our exports of corn during 1902 amounted in value to only $16,000,000, while in 1901 we sent abroad consignments worth nearly $83,000,000. The loss to our trade through the diminished shipments of this product alone exceeded $66,000,000.

Aside from the extraordinary falling off in corn exportation, the

most noticeable instance of decline occurred in the shipment of cotton. Our cotton exports for 1902 had a value of $292,000,000, or about $23,000,000 less than the figures recorded in 1901, when there were shipments worth $315,000,000.

Trade in Forestry Products.

The more active interest recently aroused in the question of forestry in the United States has created a larger demand for statistical information regarding our commerce in forestry products. To meet this demand the office devoted considerable time during the year to the preparation of statistics on the subject.

Last year the United States exported nearly $50,000,000 worth of forest products. Lumber in its various forms, not including heavy timber, comprised the principal item, the shipments under this head having a value of about $26,000,000. The exports of heavy timber, sawed, hewn, or in logs, were valued at about $10,000,000. Wood pulp and the minor products of the forest together formed an item of about $13,000,000.

Europe furnishes the principal foreign markets for American lumber. The United Kingdom is decidedly the largest purchaser, but extensive sales are also made each year to France and to Germany. Markets for our lumber, however, are found in nearly every quarter of the world. The neighboring countries of Canada and Mexico make considerable purchases. A promising market is now being developed on the island of Cuba, where in 1902 consignments worth over $1,000,000 were received. During the last few years a considerable export business in lumber has been established with the Philippine Islands. In 1902 shipments valued at $246,000 found a sale there. These islands, although rich in tropical hard woods, promise to afford an extensive market for the building lumber supplied so abundantly by the great timber districts of our Pacific slope region. Additional markets for that region will undoubtedly also be developed in other parts of the Orient.

Notwithstanding the immense timber areas of the United States, a larger sum is annually expended in the importation of forest products than is received in payment for such products exported. This is because of our extensive requirements as regards certain articles yielded only by the forests of the Tropics. It is quite probable that before many years the island possessions of the United States, and particularly the Philippine Islands, will supply a large part of the tropical forest products we are now obliged to import from foreign sources.

Trade with Island Possessions.

In view of the lively interest that is taken in the course of trade between the United States and the several island possessions, the office

recently prepared some statistics to show the status, so far as products of agriculture are concerned, of our commerce during the past fiscal year with Hawaii, Porto Rico, and the Philippines. From the statistics in question it appeared that, while our agricultural trade with Hawaii suffered a rather marked decline in 1902, there was a considerable increase in the amount of such business carried on with Porto Rico and with the Philippine Islands.

OFFICE OF PUBLIC ROAD INQUIRIES.

The work of this office has been prosecuted along the same general lines as heretofore, but its practical features have been enlarged. Object lesson and experimental road work have received more attention than ever before, and efforts along this line appear to be doing much to stimulate the building of better highways in many sections. Practical work in the testing of road materials has also been continued and enlarged. The field work of the Director, his assistant, and several road experts and special agents who attend and address conventions, consult with and advise road officials, and come in personal contact with the people of many communities, is another important feature of the practical work of the office which is producing excellent results.

Cooperation in Object-Lesson Road Work.

The building of object-lesson and experimental roads has during the past year assumed a position of higher importance than ever before in the work of the office. Most of this work during the past year has been done in cooperation with several forces, each having a special interest in the improvement of the public highways. The first of these cooperating forces, the National Good Roads Association, was organized by public-spirited citizens to promote, by agitation and organization, the improvement of the public roads. Its work is educational in character, and one of its aims is to organize State and district associations. The second of these forces, the manufacturers of road-building machinery, contributes to the cooperative work the use of machines for building sample roads as well as experts to operate and explain this machinery. The third, one or another of the great railroad corporations, contributes the use of a train, popularly known as a "good-roads train," to carry from place to place along its lines the machinery and the representatives of all the cooperating forces. In this work the railroad corporations are actuated by a desire to develop the country tributary to their lines, particularly to secure the improvement of the roads over which commodities must be hauled to and from their stations. The Office of Public Road Inquiries of the Department constitutes the fourth cooperator. Its work is advisory, supervisory, and educational. The people of the various communities

in which conventions are held and sample roads built may be mentioned as a fifth cooperating force, and a very important one, since it is not only the principal recipient of the benefits, but must furnish the money, the materials, the common labor, and the horsepower needed in building the object-lesson roads.

The character of this cooperative work can best be indicated by briefly describing the work done in the South during the past autumn, winter, and spring. In October, 1901, the Southern Railway Company fitted up a good-roads train, consisting of a locomotive and 12 cars, which carried the representatives of all the cooperating forces and the road-building machinery furnished by five of the principal concerns that manufacture such machinery in the United States. The itinerary of this train extended through six States—Virginia, North and South Carolina, Tennessee, Alabama, and Georgia—and covered a distance of 4,037 miles, the whole campaign occupying over five months. Stops of a week or more were made at eighteen different places, at each of which a road convention was held and object-lesson and experimental road work was done.

This practical work included the improvement of earth roads, the building of gravel, chert, shell, sand-and-clay, and macadam roads, the object being to utilize local materials wherever possible and to illustrate the best methods of using them. Many thousands of people attended the sessions of these conventions and took lessons in practical road work. Addresses were delivered by many men of prominence in political, educational, and religious fields, as well as by scientific and practical road builders and representative farmers. Permanent good roads associations were organized in every State visited. It is believed that the work done has aroused a deep and permanent interest in road improvement in the States visited, and has started a movement for better roads that will ultimately yield results of inestimable value to the South. Plans for work of similar character in several Northwestern States have been matured and will be carried out during the current year.

Aside from the cooperative work just described, the Office has done much sample-road work in cooperation with State and county officials, educational institutions, and experiment stations. In this way sample roads have been built in four States: Maryland, West Virginia, Ohio, and North Carolina.

The demand for object-lesson road work of the character indicated is very great and comes from all sections. The Office has been able to comply with only a small part of the numerous requests for its active participation in the building of sample roads. During the coming year work of this kind will be extended as greatly as the force and means of the Office will justify. It should be remembered that this object-lesson work costs the Department nothing except the salaries

and expenses of its employees. In view of this fact and of its great practical value, the propriety of extending work of this kind seems apparent.

The road material laboratory is operated in collaboration with the Bureau of Chemistry, and its operations have already been discussed in connection with the work of that Bureau. The increasing demand for the services of this laboratory shows that its work is appreciated by practical road builders.

Special Agents.

The plan of dividing the whole country into four areas, known as the Eastern, Middle, Western, and Southern divisions, has been retained, but, owing to lack of funds, no special agents were appointed for the Eastern and Middle divisions. The special agents in the Western and Southern divisions have done a great deal of active field work, visiting different sections, attending and addressing conventions, collecting and disseminating information, and preparing and publishing matter on road subjects. It is expected that during the current year a special agent will be at work in each of the four divisions except the Eastern.

PUBLICATIONS.

Extent of Publication Work.

All the information acquired by this Department through its several bureaus and divisions by the means at its command finds its expression necessarily in the form of publications. The duty of issuing and distributing these publications is assigned to the Editor of the Department, under whose direction they are edited and prepared for the printer. The record of his work therefore accurately reflects the activity of the other Bureaus and Divisions of the Department. The statistics of publication work for the year, as reported by the editor, show that in no previous year since the organization of the Department has this manifestation of activity in all the branches of the Department work been so apparent.

The total number of documents issued during the fiscal year was 757, of which 85 were publications of the Weather Bureau, and the total number of printed pages of new matter edited and prepared for the printer by the Division of Publications was 18,184. Counting pages of new matter, the increase in the matter edited during the year was 25 per cent over 1901 and 75 per cent over 1900. In spite of this unprecedented increase, there were in the hands of the Public Printer on June 30, 1902—the closing day of the fiscal year—112 miscellaneous publications, not including 47 Farmers' Bulletins.

Farmers' Bulletins.

Of Farmers' Bulletins, four-fifths of which are by law set aside for the use of Senators, Representatives, and Delegates, there were printed 6,150,000 copies, of which the Congressional distribution absorbed 4,289,126. While Senators, Representatives, and Delegates have failed to avail themselves of the full number of Farmers' Bulletins allotted to them, on the other hand, the number at the disposal of the Department has been inadequate.

Growth in the Publication Work.

The growth in the publication work of the Department during the past decade has been phenomenal. Every enlargement of the scope of the work of any one bureau or division, or the adoption by the Department of any new line of investigation or inquiry, inevitably brings about an increase in the work of publication. The development of the Department itself can therefore be accurately traced in the records of the Division of Publications.

Ten years ago the total appropriations for printing for this Department, including the salary roll of the Editor and his assistants, were less than $100,000. The total number of publications was 210, and the aggregate number of copies issued was 2,689,084. Last year the total appropriations for the same purposes exceeded $380,000; the number of publications issued was 757, and the aggregate number of copies 10,586,580. This increase, amounting to nearly 300 per cent in appropriations and number of copies issued and to over 250 per cent in the number of publications, obviously supplies an accurate measure of the growth and development of the Department itself.

Cost of the Department Printing.

The amount appropriated for printing for the use of this Department is, however, far from being the total amount expended for the publication work of the Department. The Yearbook and several other reports issued annually are paid for by special appropriations, and no session of Congress passes without special provision being made for the publication of several important reports for which the regular printing appropriation is inadequate. The cost of the publication work of the Department thus does not fall short of $800,000 a year, to say nothing of the fact that this enormous mass of published matter is carried free through the mails to all parts of this country, to Canada, and to Mexico, at an expense to the Government which can not be less than $200,000 yearly at the least.

The diffusion of the information acquired by the Department, therefore, represents an annual expenditure of about $1,000,000, a comparatively small per cent of the amount required to defray the total

expenses of the Department, but one, nevertheless, without which all the other expenses would be useless. A serious problem is presented by the fact that as the Department grows and becomes better known and its work more valuable and more highly appreciated, the demand for its publications increases even more rapidly than the supply, and with a constituency of over 10,000,000 workers on the 5,750,000 farms of the United States, of which probably not more than one-tenth are reached at present in anything like adequate measure by the publications of the Department, it is obvious that the demand upon us for published matter is bound to assume larger proportions, and, under the present system, to involve greater expense.

THE LIBRARY.

The work of the Department depends in a large measure upon an available collection of books relative to practical agriculture and to scientific experimentation at home and abroad. With this end in view the library has been increased from year to year until it now contains 75,000 volumes and pamphlets pertaining to the special lines of work carried on in the Department. As a working scientific library it is among the first, and as such is frequently made use of by scientists in distant parts of the country.

Accessions.

Each year some especially rare scientific works and many valuable sets of periodicals are added to the library, which are not available elsewhere in the country. With a larger appropriation more such works, in addition to current publications, could be procured to the great advantage of the public service.

The files of agricultural papers are particularly noteworthy, including representative publications from all parts of the world. This is one of the special collections most frequently consulted, and, in addition to its current value, it is a most important one as a source from which the progress of agriculture may be traced in future years. With few exceptions these publications are gifts from the publishers. Many gifts from scientific writers in the form of monographs and of reprints are also received, adding largely to the number and to the value of the annual accessions.

The most important source of accessions next to that by purchase is by exchange. The numerous publications of the Department are widely distributed to societies, universities, and other institutions of learning. In return for these, thousands of separate numbers of serial publications are received. The Library is the depository for all exchanges, that they may be systematically arranged and carefully preserved for the present and future benefit of the Department.

Technical Work.

The card catalogue is kept up to date. The last appropriation provided for an additional cataloguer to further this branch of the work. In addition to the card catalogue, a volume entitled "Catalogue of the Works relating to Botany in the Department Library" has been published. It is expected that two such catalogues of books on special subjects in the Library will be issued each year until a complete subject catalogue is thus printed.

The accessions bulletins have been published quarterly, as heretofore. Two additional bulletins, containing works relating to botany and to irrigation, respectively, have also been printed. The card index to the publications of the Department has been continued. The number of sets of the cards has been increased to meet the demands for the index from depository libraries.

Serial publications constitute so large a part of the accessions to the Library that it is necessary to devote much time and money to binding, both for the preservation of the volumes and for convenience in their use. The past year 1,300 volumes have been bound, and although this is the largest number recorded for any one year, it could well be doubled with advantage to the Library if funds permitted.

ESTIMATES AND APPROPRIATIONS.

The estimates for the fiscal year ending June 30, 1903, which were prepared in the Division of Accounts and Disbursements, were submitted to Congress through the Secretary of the Treasury with an explanation of all changes from the appropriation of the preceding year. These estimates amounted to $4,789,540, or $872,120 more than the appropriation for 1902. The amount finally appropriated for 1903 was $4,503,960. These amounts are exclusive of the $720,000 appropriated for the agricultural experiment stations, and the general printing expenses.

The statutory rolls of the Department increased from $533,640 in 1902 to $630,760 in 1903. This does not represent an actual increase either of salaries or clerical force, but was the result of the transfer to the statutory rolls, on the recommendation of the Agricultural Committees of both the Senate and House of Representatives, of clerks who have heretofore been paid from the lump-sum rolls of the Department.

During 1902 $12,600 was paid for the rent of buildings in the District of Columbia, and the appropriation for the same purpose for 1903 is $21,700.

OFFICE OF THE APPOINTMENT CLERK.

The records of this office show that on July 1, 1902, the total number of employees in the United States Department of Agriculture was 3,789, of which 1,209 were executive officers and administrative assistants, clerks, messengers, and watchmen; 2,081 scientists and scientific assistants, and 499 laborers and charwomen.

During the fiscal year ended June 30, 1902, the appointments made on certificates of the United States Civil Service Commission numbered 305, including 10 reinstatements and 19 transfers from other Departments. Thirty-five persons declined appointment on civil-service certificates. There were 108 resignations, 22 removals, and 14 deaths.

EXPOSITION WORK.

The Department of Agriculture, in connection with other Departments of the Government, has, in compliance with the law, participated in various expositions in this and foreign countries; and it is now preparing an exhibit for the Louisiana Purchase Exposition which is expected to be the best ever made by the Department.

It is not intended to make this an exhibit of agricultural products and resources, differing in that respect from exhibits prepared for expositions in foreign countries, where an effort has always been made to exhibit the products and resources of the country in the hope of increasing our trade abroad. It is expected that the articles and material exhibited at St. Louis will illustrate as nearly as possible the workings of the various Bureaus and Divisions of the Department, giving to the people who may not have an opportunity to visit the Department a chance to see what it is doing to promote the agricultural interests of the country.

The preparation of the Department exhibit devolves upon the heads of the several bureaus and divisions, under the general direction of the Assistant Secretary, Hon. J. H. Brigham, the representative of the Department on the Government board, and who has served on several previous occasions in the like capacity.

Since the elevation of the Department of Agriculture to executive rank, the President has honored it by naming its representative as the chairman of the Government board at the various expositions.

MAGNITUDE OF AGRICULTURAL INDUSTRY.

In the industrial progress made by the United States during recent years there has been no more conspicuous feature than the growth of agriculture. It is doubtful if the magnitude attained by our farming interests is generally known. According to the reports of the Twelfth Census, the fixed capital of agriculture, comprising the value of the land, buildings, and improvements, of implements and machinery, and of live stock, amounted in 1900 to about 20 billions of dollars, or four times the fixed capital invested in manufactures. During that year

there were nearly 5,740,000 farms in the United States, covering an area of 841 million acres, of which 415 million acres consisted of improved land. These farms had a total value of $16,675,000,000, exclusive of farming implements and live stock. Farm implements and machinery formed an item of 761 million dollars, while the value of the live stock on farms exceeded 3 billions of dollars.

As further indicating the importance of agriculture in the United States, it is a striking fact that, according to the returns of the last census, about 40 million people, or more than half of our total population in 1900, resided on farms. Of the 29 million persons comprising the portion of our population engaged in gainful occupations, about 10 million, or more than a third, were returned as employed in agricultural pursuits. The people that work upon the farm outnumber by more than 3 million persons those who are occupied in the manufacturing and mechanical pursuits.

In 1899, according to the census returns, the produce of American agriculture, including farm animals and their products, had an aggregate value of nearly 5 billion dollars. Some of the crop values that make up this total were almost startling in their size. The crop of indian corn, which formed the leading item, had a value of 828 million dollars. The hay and forage of the census year were worth 484 millions. Wheat, which ranks next to corn among our cereal crops, gave a return of 370 millions, while oats were produced to the value of 217 millions. Cotton, the great crop of the Southern States, was valued at 324 millions.

In addition to these foremost crops, there were numerous others yielding returns in value that ran into the millions. Live stock and their products formed an exceedingly important factor in the grand total. The animals sold and slaughtered during the year were valued at above 900 millions. The several products of the dairy—milk, butter, and cheese—comprised an item of 472 millions, while poultry and eggs together brought a return of over 281 millions.

As a result of the intelligent application of improved methods to American agriculture, the produce of our farms has enabled us to increase the volume of our exports every year. Products of agriculture form about two-thirds of our entire export trade. Last year the exports from the farm amounted to 860 millions of dollars. The science of agriculture is in rudimentary stages in all lands. The education of producers from the field, so long neglected, has recently been undertaken in earnest in the United States. Our Government is doing more for the farmer than all other nations combined. Results are justifying expenditures, and the future will still further show the value of science applied to the farm.

Respectfully submitted. JAMES WILSON, *Secretary.*

WASHINGTON, D. C., *November 29, 1902.*

DEPARTMENTAL REPORTS.

REPORT OF THE CHIEF OF THE WEATHER BUREAU.

U. S. DEPARTMENT OF AGRICULTURE,
WEATHER BUREAU,
Washington, D. C., October 15, 1902.

SIR: I have the honor to submit a report of the operations of the Weather Bureau during the fiscal year that ended June 30, 1902.

Respectfully,

WILLIS L. MOORE,
Chief of Weather Bureau.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR, WITH RECOMMENDATIONS.

FORECASTS AND WARNINGS.

The most important tropical storm of the year appeared first as a feeble disturbance in the subtropical region north of Cuba August 9, 1901. It advanced thence over the southern part of the Florida peninsula during the 10th and 11th, and recurved westward over the Gulf of Mexico by the morning of the 12th. Moving westward the storm increased greatly in intensity during the 13th and 14th, and during the 14th and 15th it recurved northward over the Louisiana coast, attended by gales of hurricane force. Warnings in connection with this storm were begun on the 10th. The estimated damage to property along the Louisiana coast amounted to over $1,000,000, and according to the estimate of the secretary of the Mobile Chamber of Commerce the value of property saved by the warnings of the Weather Bureau aggregated several millions of dollars.

The North Atlantic and West Indian forecast and storm-warning service was continued in successful operation during the year. Forecasts for the first three days out of steamers bound for European ports were issued daily at 8 a. m. and 8 p. m., and American and European shipping interests were notified of the character and probable course of the more severe storms that passed eastward from the American coast.

The following letter, dated November 15, 1901, addressed by the secretary of Lloyd's, London, to the Chief of the United States Weather Bureau, at Washington, indicates the degree of interest that is being taken in the Weather Bureau warnings by representatives of the commercial and shipping interests of the North Atlantic:

I am instructed to express to you the best thanks of the committee of Lloyd's for the forecasts of bad weather in the Atlantic with which you have been so good as to allow them to be favored, and I am desired to convey to you the congratulations of my committee on the infallibility of the predictions that have been supplied by these forecasts.

On the morning of November 1, 1901, the following message was telegraphed to the Weather Bureau offices at Hamilton, Bermuda; New York, N. Y.; Philadelphia, Pa., and Boston, Mass.: "Severe disturbance moving northward east of Turks Island will probably pass near Bermuda Saturday."

The following article from the Bermuda Colonist of November 6, 1901, verifies the accuracy of the advices furnished:

The hurricane that was predicted by the Washington Weather Bureau for Saturday arrived on time and raged around the islands for twenty-four hours. All the incoming steamers were delayed in consequence, and those that were southward bound, the New York mail steamer especially, experienced exceedingly heavy weather. The growing crops throughout the colony have suffered somewhat, and the storm damage to property has been considerable. The principal damage reported has been occasioned to government property about the islands in the Great Sound, where the prisoners of war are interned, and it is said that the preliminary estimate of the damage reaches the sum of £2,000. Reports from the westward state that the contractors for the dock-yard extension works have also sustained some loss; a large boat used for conveying laborers foundered and a large quantity of balk timber got adrift.

The first general frost-bearing cool wave of the fall of 1901 swept from the northeastern Rocky Mountain slope southward to Arkansas and Tennessee and eastward to the North Atlantic coast States, from September 17 to 20. Ample warnings were distributed throughout the districts visited by the frosts of the period referred to.

The cold waves of December, 1901, were exceptionally severe in the Lake region, the central valleys, and the Southern States. The following are among press comments made regarding these cold waves:

[From Montgomery, Ala., Advertiser of December 10, 1901.]

The cold-wave warning was issued fully thirty-six hours in advance of the cold changes; it was telegraphed to all the important towns of the State, from which points it was distributed by mail. It is learned that the information was posted in over 1,500 places in the State yesterday morning, which demonstrates the very thorough and rapid system the Weather Bureau now has for getting such warnings before those who are actually interested.

[From Pacific Rural Press, San Francisco, December 17, 1901.]

There has been some injury in the citrus-fruit and winter-vegetable districts, but, thanks to the early warnings of the Weather Bureau, those who know how to burn and smoke as a preventive from frost effects saved much property and gave a new demonstration of the efficacy of the protective measures which have been brought to high development in California.

[From New Orleans Times-Democrat, December 17, 1901, editorial.]

The Weather Bureau gave ample notice of the coming of the cold wave, and its predictions have seldom been more accurate as to the extent of the wave, the territory that would be affected by it, and the degree of cold the thermometer would record; and this warning did much to prevent any serious damage to the cane crop from the freeze by giving the planters time to prepare for it.

[From Pittsburg Post, December 16, 1901, editorial.]

Much credit is due the Pittsburg station of the United States Weather Bureau for its truthful and timely predictions in the recent sudden changes of weather in this section. Warnings far in advance of the first local intimation of a cold snap were sent to shippers of perishable goods, and thus much damage was averted that otherwise would have resulted. When the continuous rains and heavy snows set in, warnings were also sent out notifying property holders of the imminent danger of a flood.

The following warnings, telegraphed from Washington to Jacksonville for distribution in Florida, resulted in the protection of more than $1,000,000 worth of fruit, vegetables, and other property, and a direct saving of $540,000:

WASHINGTON, D. C., *December 19, 1901.*

Center of low moving rapidly southeastward over Gulf. Minimum temperature to-night in central and north Florida will equal last night, and outlook is for lower temperature Friday night. All precautions against damage by cold justified for next two nights.

WASHINGTON, D. C., *December 20, 1901.*

Temperature will fall to about 20° at Jacksonville to-night, with temperature below freezing in the interior as far south as Jupiter. Emergency warnings and notify postmasters.

The floods of the Upper Ohio River in December, 1901, are referred to by the Pittsburg Gazette, of December 16, 1901, as follows:

The disaster to a large fleet of coal boats on the river last night is shown to be not chargeable to the weather service, which sent early warning of the coming of the high waters.

The destructive floods in the Appalachian Mountain streams during the closing days of February, 1902, were anticipated by the following warning, telegraphed February 23 from Washington to Weather Bureau stations in Pennsylvania and West Virginia for distribution:

Warmer weather indicated for next two days, with conditions favorable for rain by Monday night. These conditions will be most favorable for a general breaking up of ice in the mountain rivers and streams of Pennsylvania, western Maryland, and West Virginia. Notify all interests concerned that danger from flood in low-lying land is imminent.

DISTRIBUTION OF FORECASTS AND SPECIAL WARNINGS.

Much attention has been given to the mail distribution of daily forecasts through the rural free delivery, and a substantial increase was made in this direction, although during the latter part of the year our efforts were greatly hampered by lack of funds for the purchase of the necessary supplies for carrying on this important work.

There were in operation August 1, 1902, 10,025 rural free-delivery routes, serving approximately 1,000,000 families, of which but 105,000 families (about 10 per cent), served by about 1,000 routes, could be furnished with the forecasts of the Weather Bureau from the funds available for that purpose.

The Post-Office Department estimates that there will be in operation by July 1, 1903, 15,000 routes serving approximately 1,500,000 families. With the necessary funds it would be possible to make the distribution of the daily forecasts of the Weather Bureau coextensive with the rural free delivery itself. The distribution of forecasts by this means alone would require not less than 450,000,000 blank forms for the routes that will be in operation on July 1, 1903. The purchase of these forms, together with the necessary printing appliances and the employment of the assistance required, will cost, it is estimated, not less than $100,000.

The following table shows the geographic extent of this work, as well as the increase over the distribution of the previous year:

State or Territory.	At Government expense.			Without expense to United States by—					
								Telephone.	
	Daily forecasts.	Special warning only.	Emergency warning.	Mail, daily.	Rural free delivery, daily.	Railway telegraph service, daily.	Railway train service, daily.	Daily forecasts.	Special warning.
Alabama	29	6	152	900	857	31	12	15	28
Arizona	3	1	0	0	0	0	0	4	4
Arkansas	27	7	118	528	236	6	0	72	75
California	113	13	0	2,359	2,090	356	0	150	186
Colorado	19	17	81	959	1,201	2	7	4	23
Connecticut	14	4	52	979	2,225	12	151	3	0
Delaware	10	0	25	73	890	30	0	0	0
District of Columbia	0	0	0	1,478	0	0	0	13	0
Florida	27	113	95	891	0	96	0	41	117
Georgia	40	37	268	1,568	2,045	141	41	26	348
Idaho	13	1	0	478	101	0	17	0	8
Illinois	117	28	524	3,424	7,196	127	459	175	711
Indiana	124	9	242	1,978	5,856	43	287	38	84
Indian Territory	8	0	5	154	0	0	0	0	0
Iowa	155	32	480	1,917	10,842	12	0	451	542
Kansas	66	8	217	808	3,802	29	15	3	0
Kentucky	39	37	102	1,928	75	21	0	400	407
Louisiana	24	37	71	735	125	0	0	11	49
Maine	23	5	46	1,569	1,920	0	77	3	18
Maryland	29	7	89	1,523	1,619	129	0	11	38
Massachusetts	25	22	71	3,647	2,770	0	331	16	61
Michigan	110	30	443	4,980	4,847	459	457	43	295
Minnesota	57	16	217	1,802	2,062	5	0	534	564
Mississippi	29	10	75	639	0	16	0	42	82
Missouri	102	11	280	4,204	7,323	31	0	558	323
Montana	21	3	24	638	0	0	0	12	19
Nebraska	63	12	241	1,087	1,777	0	0	37	81
Nevada	3	0	0	148	0	0	0	0	0
New Hampshire	18	1	39	682	2,730	0	31	0	0
New Jersey	29	27	127	1,181	255	176	0	40	34
New Mexico	5	2	0	15	0	7	0	7	30
New York	127	58	407	6,986	9,811	333	168	339	941
North Carolina	59	19	214	994	395	1	16	36	59
North Dakota	13	12	104	16	150	0	0	0	0
Ohio	145	92	407	7,812	22,381	38	17	1,456	4,609
Oklahoma	9	2	15	172	0	0	0	0	0
Oregon	20	2	0	795	745	0	104	0	3
Pennsylvania	68	23	345	3,922	200	827	0	1,967	768
Rhode Island	4	0	13	102	250	0	28	0	4
South Carolina	33	5	125	1,106	513	36	23	16	240
South Dakota	40	31	111	684	400	0	0	70	232
Tennessee	43	10	305	1,577	1,100	31	2	81	120
Texas	57	68	278	1,479	2,933	159	0	396	407
Utah	16	60	0	204	340	0	0	3	17
Vermont	11	1	50	598	175	9	13	1	1
Virginia	39	9	109	1,540	228	63	96	1,158	1,230
Washington	24	2	0	721	916	0	29	3	3
West Virginia	21	11	74	1,194	7	37	26	21	44
Wisconsin	69	16	447	1,802	1,733	1	16	40	63
Wyoming	6	4	8	90	40	16	0	1	1
July 1, 1902	2,146	921	7,096	74,327	105,161	3,280	2,423	8,297	12,872
July 1, 1901	1,958	985	7,096	[a]110,103	0	3,280	2,423	8,297	12,872
Changes	188	—64	0						

[a] Including rural free delivery

EQUIPMENT AND INSPECTION OF VOLUNTARY STATIONS.

The inspection of voluntary stations was undertaken on a more extensive scale than in any previous year in the history of the Bureau, and for the first time an allowance for this purpose was made each section, $1,940 having been apportioned among the several sections according to their needs. It became necessary, however, before the end of the year to cancel the authority to use the unexpended balances

on account of the uncertainty of being able to continue the inspections under the conditions prescribed. All amounts not used, therefore, by May 15 were turned in to be applied to other purposes for which the Bureau had urgent need. Less than $600 of the amount allotted for the inspection of stations was used; but with this comparatively small amount 268 stations were inspected, at an average cost of $1.94 per station. The experience gained during the year in this line will prove of decided advantage in the following year, for which an increased allowance has been made and all of which will doubtless be expended.

While 230 new voluntary stations have been established, the total number at the close of the year was but little greater than at the end of the preceding year, as 209 stations were discontinued. Efforts have been mainly directed toward the improvement of the equipment and exposure of instruments at stations already established rather than toward an increase in the number of stations. A very gratifying improvement in the character of the observations has followed. There can be no doubt that the voluntary observers of the Bureau, as a rule, now more thoroughly understand their duty and perform the same with more painstaking care than ever before. A large number of thermometers of various makes have been replaced by the standard tested instruments of the Weather Bureau, and many rain gauges not of the Weather Bureau pattern have been replaced by those corresponding to the regular station equipment. In the work of establishing voluntary stations, and improving the equipment of those already established, there have been issued during the year 607 maximum thermometers, 388 minimum thermometers, 313 thermometer shelters, and about 200 rain gauges.

COTTON AND SUGAR AND RICE SERVICES.

Four cotton-region stations have been discontinued and 18 established, 7 of the new stations being placed in the important cotton fields of Texas. These new stations constitute a valuable addition to the cotton-region service. The increase is highly appreciated by those interested in cotton. The number of sugar and rice region stations remains unchanged, there being 8 such stations. The total number of cotton and sugar and rice stations at the close of the year was 148

CORN AND WHEAT SERVICE.

Two new stations were established and none discontinued, the total number being 133.

CALIFORNIA FRUIT AND WHEAT SERVICE.

This service was inaugurated during the latter part of the previous year, at the close of which there were 8 stations. The period covered by the reports extends from June 1 to August 31. Before the resumption of the service for 1902, 12 new stations were established, the total number now reporting being 20. This service has proved very popular; it supplies information of much value to the fruit and wheat interests of California. Daily bulletins are issued by the official at San Francisco giving the maximum and minimum temperatures and rainfall for the series of stations, the bulletins being identical in character with those of the corn and wheat and cotton region services.

CLIMATE AND CROP PUBLICATIONS.

The standard of the monthly section reports has been fully maintained, and in instances improved. The value of these is now more fully recognized, and the demand for them is constantly increasing. These reports are issued with promptness, and it rarely occurs that a section bulletin is not issued before the close of the month succeeding that for which it forms the record.

The weekly climate and crop bulletins are in greater demand than at any previous time. No material change has been made in the form of the bulletins issued by the several sections. The editors of agricultural and commercial papers avail themselves largely of these bulletins.

Recognizing the importance of preserving the section publications in the most careful manner, nearly $1,500 was expended during the year in binding at each center a complete file of all the section reports issued by the several sections. We have now, therefore, at every climate and crop center, bound in substantial manner, a complete file of the reports of each and every section, so that every climate and crop-service section center is prepared to place at the disposal of inquirers detailed climate and crop information from every part of the United States.

THE WEATHER SERVICE IN CUBA.

The work that the Weather Bureau has carried on in Cuba may be divided into two classes:

(1) The climate and crop service, which is concerned with Cuba alone.

(2) The storm-warning service, of which the observation stations in Cuba form only a part of the general system operated primarily for the benefit of the commerce of the Gulf and South Atlantic coasts and the West Indies.

The Cuban section of the climate and crop service of the Weather Bureau has been turned over to the secretary of agriculture of the Cuban Republic. It consisted of 25 voluntary observation stations, each one of which was equipped with a set of thermometers, a rain gauge, an instrument shelter, and the necessary forms for the rendering of reports; it had also 86 crop correspondents.

The voluntary observers and the crop correspondents reported to Havana, and gave to the section director the data that enabled him to publish a monthly climatological report of the island and a weekly bulletin showing the condition of crops in the various provinces.

That portion of our storm-warning service located on the island of Cuba consists of an observatory at Havana, one at Cienfuegos, one at Puerto Principe, and one at Santiago. The protection of our own seaports on the Gulf and South Atlantic coasts against the approach of West Indian hurricanes renders it desirable to have a few observation stations on the island of Cuba.

A mutually beneficial cooperation has been proposed, whereby the Cuban Republic might be given the benefit of our extensive system of cable-reporting stations in return for the privilege of maintaining the four stations hereinbefore referred to.

In accordance with the request of the Cuban Government the Weather Bureau is still making forecasts for the island and cabling them to all of the commercial ports of the Republic. These warnings can only

be made by some official having daily access to the extensive system of observations collected by the United States Government from the islands and mainland around and about the Gulf of Mexico and the Caribbean Sea.

Observations taken only on the island of Cuba would not cover an area of sufficient extent to render possible the making of the most accurate warnings. The Weather Bureau has in its possession the necessary data on which the most reliable forecasts and warnings for Cuba can be made, and has been glad to render this service to the Cuban Government.

THE MONTHLY WEATHER REVIEW.

The Monthly Weather Review has been published as regularly as practicable, but the number for the month of April, 1902, was kept waiting in order to include therein an important memoir on "Rainfall and charts of rainfall," to be illustrated with a special edition of the relief map of the United States, to be furnished by the cooperation of the U. S. Geological Survey. The Review for the month of May was also delayed for about two weeks in order to include therein a plate of the bolograph spectrum furnished by the kindness of Prof. S. P. Langley, Secretary of the Smithsonian Institution. The July Review appeared on time.

As the Monthly Weather Review continues to be recognized as an important medium for the diffusion of knowledge of the results of work in all branches of climatology and meteorology, no pains have been spared to make it a credit to the Government. The general appearance of the Review has been improved by the introduction of new type and a quality of paper that allows the insertion of illustrations in the text, thereby diminishing the general cost of printing. I asked Professor Abbe to prepare a brief statement of the articles most important to meteorological science that have appeared during the past year. Special mention is made of the following:

(1) Byron McFarland: "The thunderstorm—a new explanation of one of its phenomena." In this the author maintains that the descending mass of cool air accompanying the rain, by reason of its greater density and pressure, causes the sudden rise in the barometer that generally accompanies a thunderstorm.

(2) Marcel Brillouin: "Historical introduction to his collection of original memoirs on the general circulation of the atmosphere." This is an excellent critical review of important publications on the movements of the atmosphere. The author especially enforced the necessity of studying the atmosphere in connection with the real surface of the earth, and not the ideal uniform globe that is generally considered by mathematicians.

(3) Frank W. Very: "The solar constant." This is an admirable review of the present state of our knowledge of the amount of heat received by the atmosphere from the sun, and the amounts absorbed and radiated by the air. Professor Very also gives some fundamental suggestions as to the method of investigating this subject, which is so important to meteorology. This article has been very favorably noticed by European reviewers.

(4) H. H. Kimball: "Ice caves and frozen wells." This embodies the results of a personal examination of several cases in which ice is formed and preserved under ground. Mr. Kimball gives a satisfactory general explanation of the meteorological conditions necessary to this formation of ice, showing that, in general, caves, wells, and porous ground are cooled by the percolation of cold air to such an extent that the cold ground will freeze any water that may subsequently flow into it. He cites cases of stalactites and stalagmites of ice in deserted iron mines. Taken in connection with the exhaustive descriptive work by E. S. Balch, of Philadelphia, we have now a very satisfactory idea of the process by which ice caves, ice beds, and frozen wells are formed throughout the world, and the former

hypotheses, especially that which referred them back to the Glacial age, must now be abandoned.

(5) H. H. Kimball: "The general circulation of the atmosphere," especially in the Arctic regions. In this memoir, which was a thesis for the degree of M. S., the author shows the great contrast between the theories of Ferrel, Oberbeck, and Helmholtz on the one hand, and those of Bigelow and Teisserenc de Bort on the other. He then collects and charts all available observations of the movements of the highest cirrus clouds in northern latitudes, and shows that they demonstrate the existence of a rather weak movement of the surface wind westward for latitudes north of 65°, with modifications introduced by the low barometric pressures in the North Atlantic and Bering Sea. It is probable that these modifications are appreciable, because in northern latitudes the cirri are low down, and above these there should be a stronger current from the west eastward.

(6) Prof. C. F. Marvin: "The measurement of sunshine and the preliminary examination of Angström's pyrheliometer." This paper not only introduced Angström's electric compensation pyrheliometer to the attention of American physicists, but shows how it can be best used to advance meteorological research. Three copies of this instrument have been purchased by the Weather Bureau and carefully compared before being intrusted to the hands of the respective observers. Professor Marvin's paper gives the results of these comparisons, from which it appears that the amount of heat received from the sun per minute, per square centimeter, by a surface normal to the solar rays and outside of the earth's atmosphere, is about 3.1 gram calories, and that measurements made at sea level are liable to an uncertainty of about 1 per cent.

(7) O. L. Fassig: "The westward movement of the daily barometric wave." This is a short article accompanied by important charts, showing that the principal features in the diurnal curve of local variations of barometric pressure move westward around the globe daily.

(8), (9) Mark S. W. Jefferson: "The reduction of records of rain gauges." This article calls attention to the unsatisfactory condition of our knowledge of the distribution of rainfall. The author suggests certain modifications in the methods of preparing rainfall charts. As this subject is of the greatest interest in relation to agriculture, irrigation, engineering, and general meteorology, correspondence was invited on this subject. Professor Abbe prepared an extensive "symposium" on "Rainfall and charts of rainfall," which appeared as a supplement to the Monthly Weather Review for April, 1902. In this symposium the latest rainfall charts by Prof. A. J. Henry, of the United States Weather Bureau, for the years 1871–1901, inclusive, and by Mr. Henry Gannett, of the United States Geological Survey, for the years 1871–1893, appeared, accompanied by a relief map of the United States, which must be studied in connection with the rainfall. The correspondence and extracts published in this symposium explain the methods of preparing rainfall charts, and show some of the errors of those who would apply hypothetical corrections for altitude, or would, from the presence of forests and lakes, infer a special increase of rainfall. The whole discussion emphasizes the extreme importance of a large increase in the number of our rainfall stations, in order that the Weather Bureau may satisfactorily respond to the general public demand for information as to rainfall and snowfall.

(10) Maxwell Hall: "The sun-spot period and the temperature and rainfall of Jamaica." In this paper the author shows that since 1883 there has been a close parallelism between the mean maximum temperatures at Kingston and the curve of sun-spot numbers. There is also some show of parallelism between this sun-spot curve and that of the general rainfall for Jamaica.

(11) A. Wolfer: In order to facilitate the study of solar relations, Professor Abbe reprinted in the Monthly Weather Review for November, 1901, the complete table of "Wolf's relative sun-spot numbers." This led to a correspondence with Prof. A. Wolfer, of Zurich, who stated that, as the successor to Professor Wolf, he had undertaken to revise the original series of sun-spot numbers and incorporate all newly discovered data. This revision was, therefore, published with some remarks by Wolfer in the Monthly Weather Review for April, 1902, simultaneously with its publication in Switzerland. This constitutes a most welcome addition to our knowledge of sun-spot phenomena, and while, on the one hand, it will undoubtedly stimulate research into the relations between the sun and the earth, it will, on the other hand, serve to refute many erroneous hypotheses and bring us nearer to the truth.

(12) Albert Matthews: "Indian summer." This is the result of an exhaustive search in the literature of England and America; the author shows that the term Indian summer first appeared in 1794, at which time it was probably in general

use throughout the United States. This memoir has excited very general commendation, coupled with expressions of surprise at finding that we know so little about the origin of the term and the reason for its adoption.

(13) S. P. Langley: "The Astrophysical Observatory of the Smithsonian Institution." In this article Professor Langley first describes his bolometer and his laborious, but successful, efforts to secure a bolograph made by automatic methods. The article is illustrated by a remarkably fine reproduction of Langley's original bolograph spectrum. The author calls attention to the important meteorological bearings of his studies with the bolometer. That, in fact, our seasonal weather changes and probably also the irregularities of climate from year to year are dependent upon the absorption of solar heat by the carbonic-acid gas and the aqueous vapor in the atmosphere. The absorption is greatest in Washington in August. Similar results have been attained with the actinometer of Crova at Montpellier, and, especially, by the visual observations of aqueous absorption lines in the spectrum, as conducted by L. E. Jewell at the Johns Hopkins University and published in 1896 in Bulletin 16 of the United States Weather Bureau. There can, therefore, no longer be any doubt that by means of these instruments meteorologists at sea level will be able to gauge the average and the special absorptive powers of the whole atmosphere above them. The bolograph and actinometer must, therefore, form an important adjunct in every important meteorological observatory.

(14) F. H. Brandenburg, W. V. Brown, and Prof. E. B. Garriott: "On the classification and index of weather maps and weather types as an aid to forecasting." These three articles on this subject have shown practicable methods of obtaining an end that is greatly to be desired. Professor Garriott especially calls attention to the fact that types of formations and movements of the same general character, extending over periods of several days, are much more important than types of individual weather maps or weather conditions. It is to be hoped that the great importance of this subject will stimulate further efforts in this line, but they will hardly attain complete success unless they are carried out in sympathy with correct views of the general circulation of the atmosphere. It is this latter question that offers the fundamental difficulty in all weather forecasting, and especially in long-range forecasts. An article by Professor Abbe in the December Review, "The physical basis of long-range forecasts," explains the general character and difficulties of the problem in popular language, and suggests an appropriate method of treating the general circulation of the atmosphere, as disturbed by the presence of land and water on this globe. But the most important work on this subject is that of Professor Bigelow mentioned below.

(15) Prof. F. H. Bigelow: "Studies on the statics and kinematics of the atmosphere in the United States."

Paper I. "A new barometric system for the United States, Canada, and the West Indies."

Paper II. "Method of observing and discussing the motions of the atmosphere."

Paper III. "The observed circulation of the atmosphere in high and low areas."

Paper IV. "Review of Ferrel's and Oberbeck's theories of the local and general circulations."

Paper V. "Relations between the general circulation and the cyclones and anticyclones."

Paper VI. "Certain mathematical formulæ useful in meteorological discussions."

This series of papers, published in the Monthly Weather Reviews for January–June, 1902, are important contributions. They constitute a complete summary of Professor Bigelow's researches into the physics of the earth's atmosphere and also give us a general idea of nearly all that has thus far been accomplished in this field of work. This study involves a knowledge of the conditions prevailing at and above ordinary cloud levels; therefore, the author has discussed the movements of the atmosphere, the formation of clouds, the temperatures and moistures observed by the highest balloon ascensions. He not only summarizes all the work that is published in detail in his International Cloud Report and his System of Barometry, but he prepares the way for a proper reduction of the observations of temperature, moisture, and wind made at Weather Bureau stations and for drawing of daily weather maps for several successive levels in the atmosphere. He finds that with increasing altitude above 10,000 meters the rate of diminution of temperature steadily diminishes, but recognizes that the accurate measurement of the temperature of the air in the highest strata is a very difficult process, and that all efforts to secure reliable results deserve the hearty support of meteorologists.

Among the most important papers accepted but still awaiting publication in the Monthly Weather Review are the two following:

(1) W. A. Bentley: "A report on microphotographs of snow crystals secured during the winter of 1901–2." For twenty years Mr. Bentley has devoted himself to the study of snow crystals. His collection of microphotographs taken in Jericho, Vt., surpasses the sum total of all that has been done by all others in the world, and must form the basis of all future study into the reasons for the great variety of forms that occur. It seems likely that each snowflake contains within itself traces of the processes that it has had to undergo in its journey from the clouds to the earth. Therefore the crystals should tell us of the atmospheric conditions in the regions whence they came. From this point of view it is evidently important to encourage Mr. Bentley in his labor of love. It is to be hoped that a physicist of sufficient ability may be found to associate himself with Mr. Bentley in this work and to carry it on to its successful conclusion.

(2) J. W. Sandström: "On the construction of isobaric charts." This memoir has been prepared under the general supervision of Prof. V. Bjerknes, of the University of Stockholm, and is believed to present important novelties in practical meteorology. Mr. Sandström has made special use of the splendid series of observations in the free air obtained by the Weather Bureau by means of the Marvin kite and meteorograph, during the summer of 1898. It seems likely that his studies, taken in connection with those of Professor Bigelow, will indicate the proper method of utilizing daily records from kites and balloons as supplementary to observations of the clouds by means of the nephoscope. Mr. Sandström's memoir was written in German, and is now being translated by Professor Abbe for publication.

Professor Abbe states that his duties as dean of the scientific staff and editor of the Monthly Weather Review have been greatly lightened by the valuable assistance of Mr. H. H. Kimball as assistant editor of the Review.

The recent publication of the important "Lehrbuch der Meteorologie," by Prof. Dr. Julius Hann, of Vienna, marks an important epoch in the history of meteorology. It constitutes a fairly complete summary of the present condition of our knowledge in all branches of observational meteorology, with many valuable suggestions as to the theories and explanations of the phenomena. Professor Abbe has continued the translation of this work as rapidly as other duties would permit; but it is a large undertaking and can not be finished within the coming year.

CARNEGIE INSTITUTION.

The establishment of the Carnegie Institution for research has led the trustees to address the chief of the Weather Bureau a general request for suggestions as to what this institution can do for meteorology, and the board of research appointed by the chief of Bureau has duly reported on the subject. The trustees of the Carnegie Institution have requested Professor Abbe to act as their general adviser on matters pertaining to meteorology. The chief of Bureau's report to the trustees, as also that of Professor Abbe, takes very much the same view of the subject; that is, that the Carnegie Institution should occupy those fields of research that are outside of the official duties of other institutions, but should cooperate with them as far as possible.

AËRIAL RESEARCH.

There has been inaugurated a programme of aërial research in the upper strata of the atmosphere. Professor Abbe has been given charge of this work, with the privilege of calling upon Professors Marvin, Bigelow, and others for assistance. The first duty in connection with this work has been to correspond with manufacturers of

hydrogen and with instrument makers and special aëronautic experts in the United States and Europe, in order to ascertain what is at present considered practicable and best. There is every prospect that we shall be able to send up some sounding balloons with meteorographs during the coming year. Meanwhile the most laborious part of the preparatory work falls upon Professor Marvin and will take nearly all of his time for six months to come.

SOLAR HEAT AND ATMOSPHERIC ABSORPTION.

In July, 1901, the Bureau received three copies of Angström's Electric Compensation Pyrheliometer, which instrument is intended to measure in calories the amount of heat received by radiation from any distant source, including, of course, the sun. It is intended to use these three instruments in carrying out researches on the amount of solar heat and of atmospheric absorption and allied questions. One of them is kept as a standard at the Weather Bureau and may be used in Washington; the others are now located, respectively, in Baltimore, in care of Prof. J. S. Ames, and the other in Providence, R. I., in care of Prof. Carl Barus. Numerous investigations must be carried on by these physicists as preliminary to the main object of our research. Articles published in the Monthly Weather Review by Prof. C. F. Marvin and Prof. F. W. Very, and by Mr. C. G. Abbott and Prof. S. P. Langley, have given a general idea of the scope that the investigation must take.

BAROMETRY.

The work on the barometry of the United States and Canada has been completed by Prof. Frank H. Bigelow, and the tables for the reduction of sea level have been in operation since January 1, 1902, with results which seem to be quite satisfactory. The work of preparing and checking the station tables for reductions to the 3,500-foot and the 10,000-foot planes is complete, and the individual tables will be issued during July, to be expanded at the stations, so that they will be ready for use in the autumn, as soon as the circulation begins to be vigorous.

NEPHOSCOPIC ORSERVATIONS.

A very valuable set of nephoscope observations in the West Indies Islands has been secured, beginning May, 1899, and extending to May, 1902, at 11 stations. The circulation of the atmosphere in the tropical zone has never been carefully mapped out, and these observations for the first time afford us the necessary data for discussing these problems. In view of the popular interest in the distribution of the ashes ejected from the volcanoes in May and June, it is very opportune that the prevailing currents of air in the upper strata should be accurately determined. The computations on this work have been begun. Similarly, nephoscope observations will soon be commenced in the Pacific and Plateau districts, in order to supplement those made in 1896–97 for the international commission.

VAPOR TENSION AND PRECIPITATION.

It has become necessary to discuss the Weather Bureau observations on the vapor tension throughout the United States, in view of

the fact that no attempt has ever been made to construct any normals, or to determine the seasonal variation of the precipitation as depending upon this element. These computations will necessarily involve a careful treatment of the wet and dry bulb temperatures and a consideration of the troublesome psychrometric problems that are involved.

LOSS OF LIFE IN THE UNITED STATES BY LIGHTNING.

In Bulletin No. 30 the information collected from all parts of the country during the past ten years has been brought together and summarized by Prof. A. J. Henry. It is shown in this publication that destructive lightning strokes occur with greater frequency in some parts of the country than in others; that the region of greatest frequency is in the Ohio Valley, the lower lake region, and the middle Atlantic States, and that, considering the sparsity of the population, the number of fatalities in the middle Rocky Mountain region and the upper Missouri Valley is surprisingly large. A study of the data has also enabled the Bureau to formulate a few simple precautions against danger from lightning stroke that are here reiterated:

It is not judicious to stand under or near trees during thunderstorms, in the doorways of barns, near chimneys and fireplaces, or timbers that lead directly to the room. Neither should one stand near the point of entrance of telegraph and telephone wires. (The latter should invariably be provided with lightning arresters and ground wires.) It is not advisable to huddle under wagons, thrashing machines, or under frame structures surmounted by a flag pole. A wire clothesline should not be attached to a dwelling house under any circumstances; rather suspend it between two neighboring trees or posts.

WIND VELOCITY AND FLUCTUATIONS OF WATER LEVEL ON LAKE ERIE.

Strong westerly winds on Lake Erie pile up the water in the harbor of Buffalo, at the eastern end of the lake, the rise in level at times being so great as to be detrimental to navigation and injurious to wharf property. The establishment under the direction of the Chief of Engineers, U. S. Army, of self-recording water-level gauges in Buffalo Harbor and at the western end of the lake, and the hearty cooperation of that official with the Bureau, has made it possible for Professor Henry to study the relations between the force and direction of the wind and sudden changes in the level of lake waters.

It was found that with westerly wind velocities of less than 50 miles per hour at the eastern end of the lake the changes of level in Buffalo Harbor were not great enough to menace navigation; when, however, the velocity of westerly winds passes beyond 50 miles per hour, wharf property is always more or less exposed to danger from flooding. The height to which the water will rise depends partly upon the strength, duration, and suddenness of the westerly winds and partly upon the season of the year. The winds of the warm season seldom prevail long enough to cause an overflow. It was also found that while the crest of the rise in lake level and the maximum velocity of the wind generally coincided in point of time, the water would begin to fall as soon as the crest was reached, regardless of the force of the wind, and that it would continue to fall and then rise again, in a series of oscillations up and down, until the normal level was restored.

The relations between the velocity of the wind and dangerous changes in water level seem to be sufficiently definite to attempt to forecast them for the benefit of local interests at Buffalo and the western end of the lake, especially the last named, where a knowledge of the changes in depth of water in the channel at the mouth of the Detroit River would be of great value to vessel interests.

CONVENTION OF WEATHER BUREAU OFFICIALS.

The triennial convention of Weather Bureau officials met at Milwaukee, Wis., August 27–29, 1901. There were in attendance one hundred of the directing officials of the Bureau, representing every section of the country and every branch of the weather service. The entire scientific staff, consisting of seven professors, was present and took part in the proceedings. The Secretary of Agriculture honored the convention with his presence just before its close, and in a few well-chosen remarks congratulated the convention on the achievements of the weather service and the high standard of its personnel. The citizens of Milwaukee gave the members of the convention and their guests a banquet at the Pfister Hotel on the evening of the last day of the convention. The banquet was presided over by Hon. E. C. Wall, president of the chamber of commerce. The Press Club of Milwaukee also generously entertained the convention at a reception one evening during its stay in the city.

Much work valuable to the Government service was accomplished by this gathering together of the leading officials of the Bureau. The report of the convention has been printed as Bulletin No. 31. It comprises 250 pages and contains all of the papers read before and discussed by the convention. This report will be read and studied by the officials of the Bureau who were not in attendance at the convention. By thus printing and disseminating a complete report of the convention the younger observers and officials of the Bureau are given nearly as much benefit as though they had been in attendance. The printed report contains so many valuable papers and discussions that it will be found of great interest to many who are interested in meteorological problems and who are not connected with the Government. The esprit de corps and the devotion to their chosen profession of the officials of the Weather Bureau are well shown by the fact that, although it was required that they bear the expense of attendance upon the convention, except for transportation, practically all of the prominent officials of the Bureau were in attendance, and many others were anxious to go who could not be spared from their official duties.

WIRELESS TELEGRAPHY.

Experiments in space, or wireless, telegraphy were begun January 1, 1900, in accordance with the orders of the Secretary of Agriculture, and carried on under the directions of the chief of the Weather Bureau. Prof. R. A. Fessenden was placed in immediate charge of the work and continued in that capacity until July 30, 1902, when he was succeeded by Mr. A. H. Thiessen.

While much valuable information has been secured and a fairly satisfactory experimental system has been devised, I am not able to report such progress in the investigation as would justify the Department in dispensing with its coast telegraph lines or the cables that connect certain islands with the mainland.

The hot-wire receiver, or boloscope, was found to be the most sensitive of any yet used in the experiments. Its action was positive, and during the early spring it gave excellent results; messages were transmitted with a rapidity almost equal to that of the ordinary telegraph. Quite satisfactory tests were made before a board from the Army and one from the Navy. It was thought that the Bureau had finally devised a receiver that would take the place of all others in use; but as the season advanced into summer and unstable atmospheric electrical conditions became more frequent it was found that the minute platinum loops on which the active principle of the boloscope depended would frequently burn out after connection was made with a vertical wire.

It has so far been found impossible to send messages any appreciable distance over land or fresh water, or to attune the transmitter to the receiver so as to overcome the difficulties of interference should a second transmitter generate electric waves within the same field.

I am of the opinion that the use of wireless telegraphy in its present state is limited to the transmission of messages between moving ships and between ships and the land, and that wherever permanent communication is required the cable or the land wire is the more reliable means of communication and probably the more economical.

Our experiments during the past year were conducted over a course between Manteo and Cape Hatteras, a distance of about 50 miles.

INSTRUMENTS.

STATION EQUIPMENTS.

Nearly all stations are now fully equipped with automatic instruments recording wind velocity and direction, the temperature and pressure of the air, and the duration of sunshine and rainfall. The extensive and thorough inspection of stations that has been made within the last two years has resulted in numerous recommendations by the inspectors, which, in the main, have been carried out and which have necessitated the replacing of old automatic apparatus with that of the most approved type. We have been obliged to postpone the equipment of some stations already listed to be supplied, but it is expected that these will receive attention during the next few months.

It is considered, in the present connection, that a station is fully equipped with automatic instruments whenever records of the following meteorological conditions are continuously and automatically produced, namely: Wind velocity, wind direction, temperature, pressure, rainfall, duration of sunshine.

On June 30, 1902, there were in operation 191 stations at which at least one meteorological element was automatically recorded, and in order to set forth graphically the present status of the equipment of stations, these may be separated into the following classes:

(*a*) Stations completely equipped as defined above	124
(*b*) Stations awaiting equipment as supplies become available	24
(*c*) Stations maintained by agents where the equipment is necessarily simple and hence incomplete	9
(*d*) Special display or other stations, at which records of some particular element, generally wind velocity only, is desired	17
(*e*) Regular stations now partly equipped, but which are of small importance, or so circumstanced that further additions to the present equipment are not considered desirable or necessary	17
Total	191

(*f*) New stations announced but not yet established.

In connection with the 124 stations quoted as completely equipped, it should be remarked that in addition to the automatic registers and apparatus constituting a complete equipment, 105 of the 124 stations are provided with a special so-called instrument stand, on which the automatic registers are installed to advantage, including an extra anemometer, a whirling apparatus, maximum and minimum thermometers, and a glass sunshine recorder, all arranged to exhibit these devices to visitors, etc. In order to still further improve the equipment and furnishing of stations, a series of 26 climatic and meteorologic charts were prepared and printed and sets issued to stations about two years ago. Some of these were bound, some framed separately and hung up on the walls of the offices, but finally during the past year a special set of swinging frames of ornamental pattern was designed, and about 79 stations have thus far been supplied with them. Stations with ample wall space have displayed the charts in separate frames. There are about 20 stations of this number at which 15 or more of the charts are so displayed (in wall frames). We thus have 124 stations completely equipped with automatic instruments, and the greater part of them provided in addition with special instrument stands, framed climatic charts, and extra instruments arranged for exhibit. It must be noticed that of those not equipped with instrument stands, charts, etc., many, such as the West Indian stations, for example, and some in the United States, do not really require or can not use this part of the standard outfit.

Referring again to the classified list above, it appears that if we exclude classes (*c*), (*d*), and (*e*), the stations of which do not require further equipment, and class (*f*), which pertains to the future, there remain 124 stations of the Bureau now fully equipped and 24 stations in process of equipment.

On the whole, it may be stated that the latter are now about one-half equipped; that is to say, about twelve complete sets of apparatus will be required to complete the equipment. It is confidently expected that the entire equipment at all stations will thus be completed during the current fiscal year.

STORM-WARNING EQUIPMENT.

The work of extending the equipment of steel towers and high-power lanterns of improved type at important storm-warning stations has also constituted an important piece of work assigned to the instrument division, which is directed by Professor Marvin, and this was pushed energetically during the year, as far as funds would permit. In all, 54 towers have been distributed to storm-warning stations, of which number 4 were to regular stations for special purposes. Of those issued, only 3 have not yet been erected, owing to unavoidable delays in procuring satisfactory sites and the exorbitant nature of bids for erection.

The funds available for this work during the past year were too limited to permit of the purchase of the high-power lanterns and certain other accessories required with the towers, hence none was provided. Moreover, the first six months of the past year have been mostly consumed, of necessity, in the manufacture, shipment, and installation of the towers, hence the plan was adopted of spending the sum available mostly for towers and their installation, leaving the matter of lanterns and accessories to be supplied this year. Provision

for this has already been made, but the storm-warning fund will permit of no considerable extension of the work beyond finishing matters left over from last year.

There are now 109 storm-warning and 9 special stations at which the steel towers have been installed. Of these, 48 now need lanterns, which will be issued as soon as delivered by the contractor.

TESTING AND ADJUSTING INSTRUMENTS.

This important work has grown to very great proportions with the large extensions of the service during the past few years.

All automatic instruments and registers, not only new instruments, but old ones that have been repaired, are most carefully tested in actual work and adjusted before the instruments are put in operation at stations. But few of the observers have that intimate knowledge of the theory of all these apparatus or the skill that is required to set in order instruments that may be generally out of adjustment. This delicate and important work is performed, under the direction of Professor Marvin, in a most conscientious and intelligent manner by Mr. Charles B. Tuch, whose skill and long experience with meteorological apparatus renders his service of the greatest value.

The comparison of thermometers likewise involves a large amount of painstaking, technical work. During the year about 1,400 thermometers were inspected and compared. The temperatures at which comparisons are made range from 40° below zero to 112° above, and thermometers are compared at points every 10° along the scale, with the exception of maximum thermometers, which are not compared at below 32°. This means at least nine readings on every thermometer and four to six additional readings at low temperatures on all mercurial and alcohol thermometers, making an average of about thirteen readings for each thermometer. This work and that of deducing and tabulating the corrections from the thousands of readings involved is performed in the most satisfactory manner by Mr. Samuel A. Potter.

It is only by such a rigid system of inspection, testing, comparison, and adjustment of instrumental apparatus that a high standard of excellence and accuracy can be maintained, and it may fairly be affirmed that the instruments of the United States Weather Bureau are unsurpassed in respect to their uniform excellence and accuracy by similar instruments anywhere.

MACHINE SHOP.

During the past year the old, antiquated foot lathes, formerly constituting the entire equipment of our repair shop, were replaced by new power-driven lathes and some other machinery.

The repair work on instruments fell considerably in arrears during the period of transition from the old to the new machinery, not only because of the time required in the installation and refitting of the shop, but from the fact that the complete utility of the new machinery depends upon securing a multitude of special tools, cutters, dies, jigs, etc., suited to the particular work in hand; and a great deal of time was expended in the construction of such special tools. Therefore the full value of our improved equipment will only be realized as these special accessories multiply and become more varied with continued work.

For many years we have had but two skilled mechanics in the machine shop, and in the meantime the number of complex automatic instruments at stations has increased from 10 or 15 pieces for the entire service to about 800 now in actual use throughout the service. Some of these are exposed to all degrees of weather conditions, and all are subject to more or less deterioration and wear with use. An increase in the force of skilled mechanics is much needed, in order to properly keep up the repair work on the great number of instruments now in use.

INSTRUMENTAL RESEARCH WORK.

The routine operations of the instrument division have so wholly absorbed the time, thought, and energies of Prof. C. F. Marvin, the able chief of the division, and the persons engaged therein as to leave little opportunity for serious application to the several unsolved technical problems involved in the construction and operation of meteorological apparatus. In former years the volume of routine work was much smaller and less exacting than at present; but we earnestly look forward to a time in the near future when the burden of routine duties shall diminish because of the completed state of the instrumental and storm-warning equipments. Then our experts will be able to devote at least a portion of their time to special problems.

Professor Marvin expresses high appreciation of the conscientious application and ability with which Mr. D. T. Maring, the assistant chief of the instrument division, has assisted him.

OBSERVATORY BUILDINGS.

In the act making appropriations for the Department of Agriculture for the fiscal year ended June 30, 1902, approved March 2, 1901, Congress included an item for the purchase of a site and erection of a small brick and wooden building at each of the following-named stations for the use of the Weather Bureau, at the amounts set opposite each, viz: Atlantic City, N. J., $6,000; Hatteras, N. C., $5,000; Fort Canby, Wash., $4,000; Port Crescent, Wash., $3,000; Tatoosh Island, Washington, $5,000, and Point Reyes, Cal., $3,000; and for the purchase and laying of a cable between the mainland and Tatoosh Island, Washington, including general repairs to telegraph line from Port Crescent to Tatoosh Island, Washington, $20,000; in all, $46,000, with the proviso that if any of the money for these several buildings and cable remained unexpended it might be used in the repair, improvement, and equipment of the buildings owned by the Government and occupied by the Weather Bureau at Cape Henry, Virginia, Bismarck, N. Dak., Kittyhawk, N. C., and Jupiter, Fla.

Under this authority the work was immediately taken up by the Weather Bureau, and the following buildings were erected during the year at the total cost set opposite each, viz:

Atlantic City, N. J	$6,000.00
Hatteras, N. C	5,000.00
Fort Canby (North Head), Wash	3,992.63
Port Crescent, Wash	1,000.00
Tatoosh Island, Washington	4,950.00
Point Reyes, Cal	2,989.90
Total	23,932.53

In addition, the following buildings were also repaired, improved, and equipped, and supplies purchased therefor at the total cost set opposite each, viz:

Bismarck, N. Dak	$7,064.14
Jupiter, Fla	3,358.00
Kittyhawk, N. C	125.00
Cape Henry, Virginia	5,104.25
Supplies, instruments, etc	1,647.64
Total	17,279.03

In regard to the above, however, it may be proper to add that the buildings at Port Crescent, Wash., and Jupiter, Fla., are still in course of construction, but it is expected that they will be completed within the next three months.

It was deemed advisable not to lay a cable between Tatoosh Island and the mainland, Washington, but instead to build a span wire across, in order that the balance of the money thus created might be used in the repair and improvement of the buildings above mentioned. General repairs, however, are now being made to the telegraph line from Port Crescent to Tatoosh Island, Washington, at an approximate cost of $3,000, which leaves a balance of about $1,768.44 to be covered into the Treasury. Only such portion of this special appropriation has been expended as has been absolutely necessary for the work in question, and while the unexpended balance can be used for the purchase of supplies for any of the buildings named, I have felt it my duty not to incur any additional expense against this fund, as I believed that the buildings in question were sufficiently well equipped to meet the needs of the Weather Bureau.

The press has spoken in high terms of the benefit that the buildings will be to the marine and other interests.

In view of the complimentary criticisms from the public and the economy to the Government in owning its own buildings, thereby saving the amounts now paid for rent of office quarters, I recommended that an additional appropriation of $50,000 be asked from Congress for the purchase of sites and the erection of not less than six buildings during the fiscal year ending June 30, 1903, which you approved, and Congress has made an appropriation of the amount named. The places that have been selected for these new buildings, with your approval, are Yellowstone Park, Wyo.; Amarillo, Tex.; Modena, Utah; Key West and Sand Key, Fla., and South Farallone Island, California. There has been some difficulty in providing sites for the buildings at Modena and Amarillo, and it is not believed that it will be practicable to erect these buildings before next spring.

LIBRARY.

No change has been made in the ordinary routine of the library. The facility with which the library can be consulted has been greatly enhanced by the completion of the transcribing of the author index on better size cards (standard library). Work has been begun on a subject index, a most important adjunct to a library, and one the need of which has been acutely felt for years past. No unforeseen interruption occurring, this much-needed index should be completed within the current fiscal year. Conjointly with this subject index of books, author and subject indexes of the meteorological contents of the periodicals currently received have also been started. Bibliogra-

phy is imperative in scientific research, and as soon as the present exigencies admit, more attention will be devoted to the subject of meteorological bibliography, and the endeavor will be made to close the hiatus caused by the suspension of our bibliographic work some ten years ago to its partial resumption within the last year.

The number of volumes in the library has been increased during the year by 782 accessions, most of which are meteorological reports of other weather services. Many of these works can not be accommodated for lack of space, but remain in sacks and packages stored on the floor. Arrangements, therefore, will soon be made to assign additional room to the library. The Bureau now especially encourages the study of meteorology, not only in the public schools but also in the colleges and the universities of the country. This action is attracting the attention of teachers and students to the central office. It is a place for study; a place where the advantages of the collected data of the world may be obtained, and it is the only place of the sort in this country. In modern research work two instrumentalities stand out coequal and coimportant—library and laboratory—the library, from which to learn what other workers have thought and done; the laboratory, in which to do that which oneself thinks out. The use made by our own officials of the library may be best shown by the fact that there are present more than 350 volumes charged to and in use in the different divisions and sections of the office. No record has ever been kept of daily calls for books, but it is not improbable that more than a thousand books are taken out of the library for consultation annually. Having what we believe to be the largest and most complete meteorological library extant, it should be our aim to make it the most useful.

EXAMINATIONS.

There have been held during the year 71 examinations—36 of employees not previously examined in any branch, and 35 of employees that had passed the first-grade examinations and who were taking the examinations prescribed for one or more of the other grades or had failed in some branch in which previously examined. It is believed that the purposes of the examinations could be greatly aided if the questions as marked, together with the reasons for the marking, could be submitted to the examinee, and the supervising examiner has been instructed to do so in the future. To tell one that one is in error is of course valuable, but to tell one how he comes to be in error is more valuable—it is educative.

TELEGRAPH LINES.

No change has taken place since the last annual report in the total mileage (367 miles) of telegraph and telephone lines owned and operated by the Weather Bureau, no new lines having been built nor any old ones abandoned during the year.

No extensive line repairs have been needed except on the Tatoosh Island section, where general repairs are now under way, preparatory to the reestablishment of telegraphic communication with the new station about to be erected on that island. A wire span, supported on steel towers, is in course of erection between the island and the mainland, in lieu of a submarine cable which, as costly experience during past years has demonstrated, can not be economically maintained in that locality.

Nineteen nautical miles of two-conductor cable, laid by the Signal Service of the Army in 1898, between Block Island and Narragansett Pier, R. I., were recently transferred to this Bureau. This cable has been out of working order since last January. It was our purpose to recover it, replace the defective parts, and relay it so as to parallel our old Block Island cable for use in case of an accident to the latter. On taking it up it was found to be too badly worn to justify the expense of again putting it down, and an appropriation of $40,000 is recommended for the purchase and the laying of a new cable and the purchase of ground and erection of necessary buildings at each of the two termini.

The total "this line" receipts from commercial telegrams transmitted over Weather Bureau lines during the year were $2,326.17, an increase of $597.68 over last year's receipts.

The total number of whole days and fractional parts of a day, respectively, on which telegraphic communication over Weather Bureau lines was interrupted is as follows:

From—	Whole days.	Fractional days.
Port Crescent to Neah Bay, Washington	10	55
San Francisco to Point Reyes, Cal	26	15
Edgartown to Nantucket, Mass	0	0
Block Island to Narragansett, Rhode Island	2	4
Norfolk, Va., to Hatteras, N. C	5	47
Alpena to Middle Island, Michigan	1	6
Alpena to Thunder Bay Island, Michigan	0	0

Under acts passed by the last Congress, specifications and plans are being prepared for purchasing and laying about 50 statute miles (more or less) of submarine telegraph cables, to connect Sand Key, Florida, with Key West, Fla.; South Manitou Island, Michigan, with Glenhaven, Mich., and the Farallone Islands, California, with San Francisco, Cal., via Point Reyes, Cal. A teredo-proof, one-conductor cable, with rubber insulation and twelve No. 8 guard wires, will be used for the Sand Key connection, and gutta-percha cables, with twelve No. 5 guard wires, for the others.

A short telephone line, to connect the new station at North Head, Wash., with the lines terminating at Fort Canby, Wash., is now under construction.

PUBLICATIONS.

TOTAL OUTPUT.

	Pieces.
Forecast cards:	
Manila	15,785,760
Paper	2,370,105
Station maps	4,087,792
Station forms, all kinds	2,738,130
Weather maps, Washington	539,772
Climate and crop bulletins	140,089
Monthly Weather Reviews	52,750
Lake charts	44,500
Snow and ice bulletins	31,043
Total	25,789,941

These figures relate only to work done within the division, and do not include miscellaneous printing for the Bureau done under authority

of over 800 orders. They mean that 25,750,000 pieces, weighing more than 270 tons, were here printed, cut, bound, or otherwise made into suitable packages, wrapped, and mailed.

WORK DONE AT THE GOVERNMENT PRINTING OFFICE.

	Pieces.
Forecast cards:	
Manila	13,000,000
Paper	13,000,000
Station maps	3,450,000
Total	29,450,000

These were also mailed to stations.

Other printing done at the Government Printing Office includes 2 quarto bulletins, aggregating 2,700 copies; 7 octavo bulletins, aggregating 24,500 copies, and 625,000 miscellaneous forms.

To the above quantities are to be added 2,250,000 blank forecast cards, manila, shipped direct by the contractor to stations, and 2,000,000 paper forecast cards printed here previous to, but mailed after, June 30, 1902.

ECLIPSE METEOROLOGY AND ALLIED PROBLEMS.

The track of the total solar eclipse of May 28, 1900, crossed the Southern States from New Orleans to Norfolk and afforded an unusual opportunity for studying some of the physical problems connected with the effects of solar radiation in the earth's atmosphere. The observations made in the eclipse track have been discussed by Prof. Frank H. Bigelow, and the results appear in Bulletin I, Weather Bureau, 1902, "Eclipse meteorology and allied problems." It is there shown what preliminary meteorological observations should be made for determining the position of eclipse stations. Professor Bigelow also shows that the so-called "eclipse cyclone" does not exist in the atmosphere and that the shadow bands are an absorption of light effect on the sun's crescent which is confined to the lowest layers of the atmosphere. A review of the scientific status of the problems of solar physics follows, in which the parallelism between the meteorology of the atmosphere of the sun and that of the earth is indicated.

REPORT OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., September 15, 1902.

SIR: I have the honor to submit herewith a report of the operations of this Bureau for the fiscal year ended June 30, 1902.

Respectfully,

D. E. SALMON,
Chief.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR, WITH RECOMMENDATIONS.

INSPECTION DIVISION.

MEAT INSPECTION.

The inspection of cattle, sheep, calves, and hogs and their products was conducted at 154 abattoirs and packing houses in 49 cities. Inspection was begun at 12 establishments, 10 in cities where it was already in operation and 2 in two other places. The net decrease of 2 cities and 2 abattoirs is due to the withdrawal of inspection owing to the cessation of business or to its restriction to local trade. Horses were inspected at one other abattoir.

The following table shows the number of establishments and cities where inspection has been conducted:

Number of establishments and cities where inspection was conducted, 1891 to 1902.

Fiscal year.	Number of establishments.	Number of cities.	Fiscal year.	Number of establishments.	Number of cities.
1891	9	6	1897	128	33
1892	28	12	1898	135	35
1893	37	16	1899	139	42
1894	46	17	1900	149	46
1895	55	19	1901	157	52
1896	102	26	1902	155	50

The following table shows the number and kinds of animals inspected before slaughter and the number of these that were rejected for some cause apparently unfitting them for food purposes, the final condem-

nation or passing of the carcass depending upon the result of the post-mortem inspection:

Ante-mortem inspection for the fiscal year 1902.

Kind of animal.	For official abattoirs in cities where inspections were made.	For abattoirs other than official and miscellaneous buyers.	Total inspections.	Rejected (subject to result of post-mortem inspection).	
				At abattoirs.	In stock yards.
Cattle	5,733,698	4,062,752	9,796,450	340	41,657
Sheep	7,497,738	5,059,054	12,556,792	1,180	15,633
Calves	515,442	323,785	839,227	1,259	4,240
Hogs	25,096,684	10,867,846	35,964,530	3,576	63,736
Horses	1,649		1,649		
Total	38,845,211	20,313,437	59,158,648	6,355	125,266

There was an increase of 1,919,502 in the number of animals inspected for official abattoirs, horses only showing a slight decrease, and an increase of 2,789,338 in the total number of inspections.

The inspection of animals at time of slaughter, with the number of carcasses and parts of carcasses condemned and tanked, is shown in the following table. The number of condemnations for trichinosis is given under the head of "Microscopic inspection of pork."

Post-mortem inspections for the fiscal year 1902.

Kind of animal.	Number of inspections.			Carcasses condemned.			Parts of carcasses condemned.
	For official abattoirs.	On animals rejected in stock yards.	Total.	For official abattoirs.	Animals rejected in stock yards.	Total.	
Cattle	5,559,969	29,722	5,589,691	10,599	3,684	14,283	3,414
Sheep	7,434,878	9,075	7,443,953	4,020	2,790	6,810	71
Calves	555,836	715	556,551	125	445	570	26
Hogs	25,277,107	34,674	25,311,781	35,821	4,471	40,292	13,934
Horses	1,649		1,649	25		25	
Total	38,829,439	74,186	38,903,625	50,590	11,390	61,980	17,445

In addition to the carcasses condemned as above and to those condemned for trichinosis, the table below shows the number tanked for other reasons—bodies of dead animals taken from cars or pens at abattoirs, or animals that, after inspection in the stock yards, had died from disease or injury or were killed by municipal inspectors:

Manner of death.	Cattle.	Sheep.	Calves.	Hogs.	Horses.	Total.
Died in stock yards	312	1,036	151	3,273		4,772
Killed in stock yards	189	26	5	10,802		11,022
Died at abattoirs	299	1,323	195	10,959	48	12,824
Total	800	2,385	351	25,034	48	28,618

On the next page is a statement of the total number of carcasses and parts condemned and tanked, with the causes of condemnation,

at the time of slaughter, and including the carcasses of animals found dead and those killed by city inspectors.

Causes of condemnation of carcasses and parts of carcasses, fiscal year 1902.

Cause of condemnation.	Cattle.		Sheep.		Calves.		Hogs.		Horses.
	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.
Actinomycosis	1,264	652			4		36	38	
Tuberculosis	7,944	152	26		13		14,927	4,700	
Caseous lymphadenitis			978	1					
Cholera and swine plague							16,989		
Texas fever	157				36				
Echinococcus	1		4				1	74	
Measles							10		
Scabies			15				52		
Eczema							8		
Erysipelas							25		
Cancer	42		3				11		
Tumor	20	1	3	2	1		411	685	
Abscess	108	1,530	50	4	10	5	626	1,792	1
Pneumonia	141		235		10		744		
Pleurisy	8		11	1			58	21	
Carditis	1								
Enteritis	28		64		3		263		1
Peritonitis	152		58		26		445		1
Metritis	21		14				135		
Nephritis	4		14		1		26		
Uremia			18				20		
Mammitis			2				5	327	
Septicemia	179		128		14		623		12
Pyemia	250		103		9		1,830		1
Gangrene	4		3		2		27		
Anemia, emaciation, marasmus	2,791		3,632		66		573		3
Ascites and anasarca	19		49				44		
Jaundice	9		190		2		673		1
Extreme temperature, various causes			47		7		1,106		1
Pregnancy	75		36				350		
Recent parturition	16		6				50		
Hernia	3		8				15		
Downers, bruised, injured, etc	1,040	1,079	1,086	63	54	21	209	6,297	
Asphyxiation	6								
Impaction of rumen			1						
Distoma			7						
Sick			19						
Too young					311				
Melanosis					1				4
Dead from various causes	611		2,359		346		14,232		48
Killed by city inspectors	189		26		5		10,802		
Total	15,083	3,414	9,195	71	921	26	65,326	13,934	73

The following table, showing for the fiscal years 1891 to 1902 the total number of animals inspected at time of slaughter for abattoirs having inspection, is given for the purpose of comparison:

Number of animals inspected at slaughter for abattoirs having inspection, fiscal years 1891 to 1902.

Fiscal year.	Cattle.	Calves.	Sheep.	Hogs.	Horses.	Total.
1891	83,889					83,889
1892	3,167,009	59,089	583,361			3,809,459
1893	3,922,079	92,947	870,512			4,885,538
1894	3,861,594	96,331	1,020,764	7,648,146		12,626,835
1895	3,704,042	116,093	1,428,601	13,616,539		18,865,275
1896	3,985,484	256,905	4,629,796	14,250,191		23,122,376
1897	4,242,216	273,124	5,209,161	16,808,771		26,533,272
1898	4,418,738	244,330	5,496,904	20,893,199		31,053,171
1899	4,382,020	246,184	5,603,096	23,836,943	3,332	34,071,575
1900	4,841,166	315,693	6,119,886	23,336,884	5,559	34,619,188
1901	5,219,149	413,830	6,639,212	24,642,753	1,992	36,916,936
1902	5,559,969	555,836	7,434,878	25,277,107	1,649	38,829,439

The meat-inspection tag or brand was placed upon 19,694,665 quarters, 250,141 pieces, and 3,820 sacks of beef; 7,419,287 carcasses of sheep, 554,016 carcasses of calves, 1,253,083 carcasses of hogs, and 793,471 sacks of pork.

The meat-inspection stamp was affixed to packages of meat products that had received the ordinary inspection as follows: 7,166,490 of beef, 39,229 of mutton, 8 of veal, 15,835,520 of pork, and 638 of horseflesh, a total of 23,041,885.

The number of cars sealed containing inspected meat products for shipment to official abattoirs and other places was 64,730.

The number of certificates of ordinary inspection issued for meat products for export, exclusive of horseflesh, was 32,744. Of beef, there were 1,571,305 quarters, 19,728 pieces, 3,845 bags, and 1,582,549 packages, with a weight of 416,990,762 pounds; of mutton there were 85 carcasses and 26,942 packages, weighing 1,145,248 pounds; of pork there were 94,962 carcasses and 658,139 packages, weighing 188,360,011 pounds. These figures show a decrease from the previous year of 35,839,611 pounds of beef and 42,784,927 pounds of pork.

There were 11 certificates issued for horseflesh, the export consisting of 638 packages, weighing 170,968 pounds.

The following table shows for several years the quantities of beef, mutton, and pork for export which received the certificates of inspection, not including microscopically examined pork:

Quantities of beef, mutton, and pork for export upon which certificates of ordinary inspection were issued, 1898 to 1902.

Fiscal year.	Beef.	Mutton.	Pork.
	Pounds.	*Pounds.*	*Pounds.*
1898	339,650,091	324,996	244,956,482
1899	360,843,856	525,705	278,696,435
1900	438,138,233	680,897	272,050,663
1901	452,830,373	894,648	231,144,938
1902	416,990,762	1,145,248	188,360,011

Expenditures on account of the foregoing amounted to $638,592.79. The cost of each of the 59,158,648 ante-mortem inspections averaged 1.08 cents.

The following shows the cost of each ante-mortem inspection from 1893 to 1902, inclusive:

	Cents.		Cents.
1893	4.75	1898	0.80
1894	1.75	1899	.88
1895	1.10	1900	.95
1896	.95	1901	1.01
1897	.91	1902	1.08

MICROSCOPIC INSPECTION OF PORK.

The number of carcasses examined was 681,865, classified as follows: Class A (free of all appearance of trichinæ), 664,288, or 97.42 per cent; Class B (containing trichina-like bodies or disintegrating trichinæ), 10,085, or 1.48 per cent; Class C (containing living trichinæ), 7,492, or 1.10 per cent.

During the first half of the year livers were examined separately from the carcasses, and 350,800 examinations were made. The number of livers so examined was 892,191, of which 869,073 were in Class A and 23,118 in Class C. As three livers were usually examined :

one time, and all were condemned if trichinæ were found in the preparation, the number in Class C does not indicate the actual number infested.

There were 7,481 trichinous carcasses, weighing 1,585,627 pounds, and 68,801 pounds of livers disposed of during the year. About one-half was tanked and the rest made into cooked meat.

The number of certificates issued for microscopically inspected pork products for export was 5,613; the number of packages stamped and exported was 95,508, with a weight of 33,681,229 pounds. The decrease in the exports amounted to 2,261,175 pounds.

The following shows the exports of pork to countries requiring certificates of microscopic inspection from 1892 to 1902:

	Pounds.		Pounds.
1892	22,025,698	1898	120,110,356
1893	8,059,758	1899	108,858,149
1894	18,845,119	1900	55,809,626
1895	39,355,230	1901	35,942,404
1896	21,497,321	1902	33,681,229
1897	42,570,572		

The cost of the microscopic inspection was $123,947.31. This is an average of 12 cents for each examination and 0.368 cent for each pound exported.

INSPECTION OF VESSELS AND EXPORT ANIMALS.

The number of certificates of inspection issued for American cattle exported to Europe was 1,102; the number of clearances of vessels carrying inspected live stock was 837. The figures show a falling off in the exports of American animals, there being 91,336 cattle, 16,710 sheep, and 13,985 horses fewer than during the previous year. The number of Canadian cattle and sheep exported from United States ports was increased. All of the animals in the following table were exported to Great Britain with the exception of 301 cattle, 200 sheep, and 412 horses to Belgium, 198 sheep to France, and 124 horses to Germany.

Number of inspections, etc., of American and Canadian animals, fiscal year 1902.

Kind of animal.	American.				Canadian.		
	Inspections.	Rejected.	Tagged.	Exported.	Inspected.	Rejected.	Exported.
Cattle	584,040	1,491	304,441	[a] 293,386	72,726	47	72,679
Sheep	401,132	266		[b] 211,224	52,445	74	52,371
Horses	19,990	86	11,272	[c] 10,967	337	2	335

[a] 7,904 via Canada. [b] 280 via Canada. [c] 80 via Canada.

In addition, there were inspected for export to other countries 1,960 cattle, 954 sheep, 8 horses, and 21 mules, as follows: Bermuda, 1,854 cattle, 714 sheep, 7 horses; Brazil, 34 cattle; Africa, 45 cattle; British Guiana, 80 sheep; Barbados, 160 sheep; Jamaica, 21 mules, 1 horse; Costa Rica, 10 cattle; Newfoundland, 17 cattle.

The number of American and Canadian animals landed alive at the foreign-animals wharves in London, Liverpool, and Glasgow, and inspected by inspectors of this Bureau stationed at these ports, together with the number and percentage lost in transit, is shown in the table on the next page.

Number of animals inspected at time of landing in London, Liverpool, and Glasgow, and loss in transit, fiscal year 1902.

From—	Cattle.			Sheep.			Horses.		
	Landed.	Lost.		Landed.	Lost.		Landed.	Lost.	
	No.	*No.*	*Per cent.*	*No.*	*No.*	*Per cent.*	*No.*	*No.*	*Per cent.*
United States	284,339	378	0.13	211,617	1,890	0.89	10,869	71	0.65
Canada	65,343	153	.23	49,679	881	1.78	295	6	2.03
Total	349,682	531	.15	261,296	2,771	1.06	11,164	77	.69

INSPECTION OF IMPORTED ANIMALS.

The numbers and kinds of animals imported from Mexico and inspected at ports of entry along the international boundary line are shown in the table following:

Importation of Mexican animals, fiscal year 1902.

Port of entry.	Cattle.	Sheep.	Lambs.	Asses.	Horses.	Mules.	Goats.	Hogs.
Eagle Pass, Tex	292				5	10	1,736	
El Paso, Tex	43,021				3	26		
Nogales, Ariz	20,550			9			114	64
San Diego, Cal	1,350	2,703	1,073	6			240	
Total	65,213	2,703	1,073	15	8	36	2,090	64

There were also inspected animals imported in bond as follows: At Nogales, 640 cattle, destined to Lower California; at El Paso, 3,622 cattle, 26 horses, 4 mules, and 2 asses, destined to Canada.

Through ports on the seacoast animals not subject to quarantine were imported as follows:

From—	Horses.	Ponies.	Mules.	Zebra.	Water buffaloes.	Bears.	Monkey.	Dogs.
Europe	2,206	58	11	1				
Bermuda	13							
Porto Rico	1	2						
Cuba	11							
Mexico	4		1					
South America	1							
Algiers			1					
Manila	2				4			
China	3							
Canada	42		1					2
New Zealand						4		
Ceylon							1	
Total	2,283	60	14	1	4	4	1	2

A statement of other animals imported through ports along the Canadian border and through quarantine stations on the Atlantic coast will be found in the report of the "Miscellaneous division."

CONTROL OF CONTAGIOUS DISEASES.

Southern cattle inspection.—The supervision of the movement of cattle from the area quarantined on account of Southern, or Texas, or splenetic, fever of cattle, due to the presence of the tick (*Boophilus annulatus*) which carries the infection, involved the proper yarding in the quarantine divisions of the different stock yards of 1,126,490 head of cattle during the quarantine season of 1901. To transport these cattle required 42,354 cars, each of which had to be placarded, and all of the waybills, manifests, and bills of lading accompanying the shipments had to state that the cattle were Southern cattle. The number of cars cleaned and disinfected was 46,736.

In Texas 418,566 cattle were inspected and identified by brands as originating outside of the quarantined district and were permitted to be moved for grazing to Northern States.

Scabies in sheep.—The number of sheep inspected in stock yards, at feeding stations, and at many places throughout the West, in order to prevent the shipment of sheep affected with or that had been exposed to scabies, amounted to 11,186,661. The number of sheep dipped under the supervision of Bureau inspectors was 1,017,162. The number of cars cleaned and disinfected was 791. For shipments of sheep that were found free of infection certificates of inspection were given.

BIOCHEMIC DIVISION.

The routine work of this division in the preparation and shipment of tuberculin and mallein has been continued. Large quantities of tuberculin have been shipped, and a large amount of mallein has been supplied, especially to the War Department and to State officials entitled to receive it. According to the records, about 55,000 doses of tuberculin have been sent out to 33 different States and 12,000 doses of mallein to 25 different States. During a portion of the year stamping ink for meat has been prepared and 312 gallons shipped.

A limited amount of tetanus antitoxin has been prepared in conjunction with the experiment station of the Bureau. A great deal of work has also been done in connection with a comparative study of the tuberculosis germs from various sources. The virulence of the bovine germ for monkeys has been established and a preliminary note on this work published. Our work was the first recorded to show that the bovine germ was pathogenic for monkeys. A number of different varieties of the tubercle germ have been obtained from children and adults in the various hospitals of Washington City, and their morphological and cultural characteristics and virulence for small animals, as well as cattle, have been and are being tested.

A very valuable piece of work has been done by Dr. M. Dorset, assistant chief of the division, in suggesting the use of a solid medium for cultivating the tuberculosis germ, namely, the substitution of egg for blood serum. The great ease with which this can be prepared and the very satisfactory character of the results obtained make this work of great importance. In addition to this, there has been published a chemical analysis of tubercle bacilli derived from various animals. This laboratory was the first to publish, some years ago, a report upon a complete chemical analysis of the tuberculosis germs of human origin. The work above referred to, which is a continuation of this line of investigation, includes, in addition to the germs of human origin, those derived from the horse, hog, cow, birds, and dogs. The results of these comparative analyses are of importance, not only in corroborating our suppositions that the composition of the various tubercle bacilli is influenced by their surroundings, but also in indicating other points for further investigation in connection with the treatment of this disease.

The experiments in connection with hog cholera and swine plague have also been continued both at the experiment station and in the West. Progress has been made and new factors of importance discovered. The feeding experiments of poultry have been continued and the results of the work are about ready for publication. A number of routine examinations of various sorts in connection with the work of the Bureau have also been made.

It is proposed during the coming year to continue the routine work

above noted, and also the investigations already started, and to begin as many others as the facilities of the laboratory will allow.

DIVISION OF PATHOLOGY.

The most important branches of work upon which this division has been engaged during the past fiscal year are the following:

(1) The investigation of a fatal infectious disease of chickens, to which the name of "apoplectiform septicemia" has been given.

(2) The preparation for publication of the results obtained in the investigation relative to "the infectiveness of milk from cows which have reacted to the tuberculin test."

(3) An investigation concerning the comparative virulence of tubercle bacilli from human, bovine, ovine, porcine, and simian sources.

(4) An investigation of a highly fatal enzootic among the cattle in a dairy herd in the vicinity of the city of Washington.

(5) A preliminary study of a progressive, chronic, but nevertheless fatal disease among Angora goats, which has been brought to our attention from Massachusetts, Pennsylvania, Maryland, Virginia, and Missouri.

(6) An investigation of the so-called maladie du coït among horses in Nebraska, with particular reference to the probability of its ultimate extirpation.

(7) The preparation and distribution of blackleg vaccine.

(8) A continuation of the inoculation experiments and microscopic examinations for the purpose of determining the prevalence of rabies in the District of Columbia.

(9) The preparation of tubes of grasshopper disease fungus for distribution by the Division of Entomology.

(10) Experiments relative to the preparation of a harmless but efficient anthrax vaccine.

(11) The preparation, installation, and supervision of a pathological exhibit at Buffalo, N. Y., and Charleston, S. C.

(12) The determination of pathological specimens sent to the Bureau for diagnosis and the preparation of answers to inquiries relative to the character, cause, and treatment of various diseases of domestic animals.

APOPLECTIFORM SEPTICEMIA IN CHICKENS.

A highly fatal disease in chickens, to which the name "apoplectiform septicemia" has been applied, was observed on a farm in northern Virginia during the past year. The nonpyogenic streptococcus isolated as the causative agent in the outbreak is possessed of unusual virulence for chickens, causing sudden death without premonitory symptoms and with a mortality of 100 per cent of those affected and 92 per cent of the entire flock. The nature, etiology, and prevention of this affection have been studied and the results of the investigation published as Bulletin No. 36 of this Bureau.

INFECTIVENESS OF MILK FROM TUBERCULOUS COWS.

As a result of the elaborate experiment which was conducted in this laboratory for the purpose of establishing the presence or absence of the tubercle bacilli in the milk of tuberculous cattle, a paper has been prepared entitled "Infectiveness of milk from cows which have reacted to the tuberculin test." This paper contains the final results obtained from the inoculation and ingestion experiments conducted upon guinea pigs with the milk of the tuberculous cows at the Government Asylum for the Insane, together with the positive findings recorded

in 57 similar experiments made by competent investigators in this and foreign countries. This experiment lasted ninety days and included the milk of 56 tuberculous cows. A synopsis of the results shows that one or more of the guinea pigs fed with milk from 9 different cows have succumbed with typical tuberculosis; that is, the milk of 16.1 per cent of the 56 reacting cows has been found to be pathogenic to guinea pigs when fed to them. Of the experiment animals inoculated intraabdominally, in the first series at least, one guinea pig has died of tuberculosis in each of six different instances, showing that the milk of 10.7 per cent of the 56 reacting cows in this experiment has proved fatal to guinea pigs in the first inoculation experiment. In the second series of intraabdominal injections the milk from 7 individual cows out of 45 examined, or 15.5 per cent, was demonstrated to possess virulent tubercle bacilli. By uniting these inoculation results it will be observed that 11 out of 56 cows, or 19.6 per cent, secreted milk which transmitted tuberculosis to one or more experiment animals when injected into the peritoneal cavity.

Owing to the greater percentage of positive results obtained from the second inoculation experiment, conducted more than two months after the first intraabdominal test, it appears probable, as would be expected, that the virulence of the milk increased with the advancement of the disease in the cow. The lack of uniformity of results obtained in many of the cows might be explained from our knowledge that tubercle bacilli are not excreted by the normal udder with any degree of constancy. For this reason the continuous feeding experiment, covering a period of three months, seems to have more practical value in demonstrating the transmission of tuberculosis than the inoculation test, where the only possibility of affirmative results must depend on the contingency of the accidental excretion of the bacilli on one particular day.

The combined results of the ingestion and inoculation experiments show that the milk of 12 out of 56 reacting cows, or 21.4 per cent, has at one time or another since the beginning of the experiment contained virulent tubercle bacilli.

Cover-glass preparations of the centrifugalized sediment of milk from 4 out of 55 cows, or 7.3 per cent, revealed the presence of the tubercle bacillus, and in two of these cases the centrifugalized cream was also found to possess this organism. In one case (cow No. 10) tubercle bacilli were only demonstrated by microscopic examination of the centrifugalized sediment. The number observed were very few, 3 in one slide and but 1 in another, while the remaining 9 cover-glasses were apparently free from this bacillus. It appears singular that positive results were not obtained by the intraabdominal injection of this sediment from which the cover-glasses showing the tubercle bacilli were made. Wyssokowitsch, in his experiments regarding the quantity of bacilli requisite for the production of tuberculosis by injection into the peritoneal cavity, found that it required at least 30 bacilli for the transmission of the disease. Granting this conclusion, it is evident that the milk injected either did not contain a sufficient number of bacilli to cause the disease or that the bacilli were less vigorous or the guinea pigs more resistant than in the other experiments. It is also of interest to know that of the guinea pigs that succumbed to tuberculosis as a result of intraabdominal inoculations, 7 were injected with a mixture of milk and cream, 5 with

centrifugalized cream alone, and the remaining 8 with the milk sediment.

COMPARATIVE STUDY OF TUBERCLE BACILLI FROM VARIOUS SOURCES.

In view of the widespread interest now manifested concerning the intercommunicability of bovine and human tuberculosis, this line of investigation has been inaugurated, and a comparative study is at present being made of tubercle bacilli isolated from the mesenteric glands of a sheep, hog, cow, and 4 children, as well as those from the sputum and from the lung of a spontaneous case of tuberculosis in a monkey. The result of this investigation will be published as soon as the work has been completed.

ENZOOTIC AMONG DAIRY CATTLE.

An outbreak of a disease among the cattle on a dairy farm in this vicinity was brought to the attention of the Bureau last November by a local practitioner who requested consultation. The affection was accompanied by certain symptoms and post-mortem changes which apparently were dissimilar to any that have hitherto occurred in this locality. Owing to the proximity of the laboratory and the probability of the disease being at times existent but as yet unrecognized in other sections of the country, a thorough bacteriological examination was made, with the result that the etiological factor was found to be a bacillus of the enteriditis group. A paper on the subject is about completed which includes the results of this investigation, together with a comparison of allied organisms which have been isolated by Gaertner from the kidney and muscles of a cow; by Basenau from the organs of a cow which was supposed to have been suffering with parturient septicemia; by Foulerton from the muscle juice and kidney of an ox condemned as unfit for food, and by Thomassen from an outbreak which he describes as "a new septicemia of calves."

INFECTIOUS DISEASE OF ANGORA GOATS.

During the past winter information reached the Bureau from Massachusetts, Pennsylvania, Maryland, Virginia, and Missouri regarding the presence of a fatal disease affecting Angora goats. The common goat (*Capra hircus*) is popularly regarded as being immune from almost all diseases, but the appearance of an enzootic in several localities among well-bred Angoras seems to indicate either that this opinion is incorrect or that Angoras are more susceptible to disease than common goats. The economic importance of this affection becoming apparent from its virulence and the widespread points of infection, an official of the division was directed to make a complete investigation of the disease as it existed in Pennsylvania, with the view of discovering its etiology. A preliminary report on the nature and cause of this outbreak, including a comparison with probably a similar goat disease that has occurred in Saxony and Switzerland, will be ready for publication very soon.

ERADICATION OF THE SO-CALLED MALADIE DU COÏT.

The constant reappearance of this venereal disease among horses in Nebraska, after it apparently had been stamped out on several different occasions by inspectors of the Bureau detailed for this work, has occasioned a thorough investigation of the disease for the purpose of obtaining information regarding its latent qualities and other peculiarities, and incidentally to confirm, if possible, the work of

Buffard and Schneider and Nocard regarding the etiological significance of the *Trypanosoma equiperdum*. This investigation is at present under consideration, but has not sufficiently progressed to warrant any conclusion at this time.

BLACKLEG VACCINE.

The demand for blackleg vaccine is gradually increasing as this method of preventive treatment becomes better known and its merits more widely heralded.

The number of doses of vaccine distributed during the past year and the results obtained in the previous year from its use may be more conveniently and vividly expressed by means of the appended tables:

Number of doses of vaccine distributed during fiscal year ended June 30, 1902.

July 1 to December 31, 1901:	
July	54,280
August	73,085
September	158,635
October	258,220
November	240,770
December	164,455
January 1 to June 30, 1902:	
January	144,230
February	92,800
March	145,960
April	162,785
May	112,570
June	80,775
Total	1,688,565

Results obtained from vaccine distributed during fiscal year ended June 30, 1902.

State or Territory.	Number of reports.	Number of cattle vaccinated.	Deaths same season previous to vaccination.		Died after vaccination.					Percentage of deaths after vaccination.
					Within 48 hours.	From 2 to 7 days after.	Within 1 year.	Number of cases due to mistakes.	Total number.	
			Number.	*Per cent.*						
Arizona	12	2,091	64	3.06	4	6	2	3	15	0.28
California	28	7,908	187	2.36	3	20	16	1	40	.46
Colorado	383	67,210	1,349	2.01	21	25	269	13	328	.44
Idaho	26	2,592	40	1.54	1		1	1	3	.04
Indian Territory	42	9,114	404	4.43	3	15	25	5	48	,44
Iowa	85	8,616	177	2.05	6	3	37		46	.47
Kansas	733	96,782	1,654	1.72	40	111	209	14	374	.30
Kentucky	23	1,458	37	2,54		1	4	6	11	.35
Minnesota	19	6,718	61	.91		1	26	1	28	.40
Missouri	162	18,649	483	2.60	5	8	40	21	74	.26
Montana	62	10,920	273	2.45	9	13	34		56	.43
Nebraska	944	92,990	3,076	3.31	53	82	395	4	534	.48
New Mexico	15	3,868	30	.78	2	5	2		9	.18
North Carolina	24	1,706	75	4.39	1	3	5		9	.47
North Dakota	263	39,168	1,064	2.72	11	17	118	3	149	.34
Oklahoma	141	23,408	939	4.09	4	19	69	4	96	.38
Oregon	19	3,456	108	3.12	1		1		2	.05
South Dakota	388	44,681	1,250	2.80	28	21	118	18	185	.31
Texas	430	90,788	2,020	2.22	48	144	467	6	665	.67
Utah	23	2,969	268	8.93		6	17	2	25	.77
Virginia	149	6,514	235	3.62	2	13	68		83	1.24
Washington	18	685	63	9.13	2	2	1	1	6	.44
West Virginia	42	1,556	41	2.62		4	4		8	.51
Wyoming	106	17,401	672	3.86	8	3	65	4	80	.38
Other States	52	4,380	247	5.64	4	14	9	1	28	.52
Total	4,192	565,628	14,817	2.62	256	536	2,002	108	2,902	.51

If we eliminate the number of animals that were probably infected before they were vaccinated, and which died within forty-eight hours after the injection, also the number of deaths that were acknowledged by the stockowners to be the result of their own mistakes, the number of cases that died after vaccination is reduced to 2,538, or 0.45 per cent.

RABIES.

During the fiscal year rabies continued to exist in the District of Columbia and adjacent sections. In consequence of inoculation tests and microscopic examinations made with the medulla and plexiform ganglion, respectively, of suspected cases, the following positive results have been obtained:

Results of inoculation tests and microscopic examinations for rabies.

Date.	Record number.	Source.	Animal inoculations.	Histological examination.	Persons bitten.	Animals bitten.
1901.						
July 19	202	Dog	Positive	None made.		
July 24	205	Dog	Positive	None made.	Boy	
Aug. 7	210	Dog	Positive	None made.		
Aug. 8	211	Dog	Positive	None made.		
Oct. 3	216	Dog	Positive	Positive	Girl	
Oct. 9	217	Dog	Positive	None made.	Man	
Oct. 14	218	Dog	Positive	Positive	Man and woman	3 dogs.
Nov. 29	220	Cow	Positive	None made.		
1902.						
Jan. 24	222	Dog	Positive	Positive	Woman	
Jan. 24	223	Dog	Positive	Positive		
Mar. 4	224	Woman	Positive	Positive		
Mar. 20	225	Dog	Positive	Positive		2 dogs.
Mar. 28	228	Dog	Positive	Positive		
Apr. 3	230	Cow	Positive	None made.		
Apr. 14	233	Dog	Positive	Positive		
Apr. 19	235	Dog	Positive	Positive	Man and child	
Apr. 22	236	Dog	Positive	Positive		
May 7	241	Horse	Positive	None made.		
May 14	243	Cow	Positive	None made.		
May 22	246	Dog	Positive	Positive		Several hogs.
May 31	247	Hog	Positive	None made.		
June 4	249	Dog	None made.	Positive		
June 13	250	Dog	Positive	Positive	Man	
June 18	252	Dog	Positive	Positive		Several dogs.
June 30	253	Dog	Positive	Positive		2 dogs.

GRASSHOPPER DISEASE FUNGUS.

The Division of Entomology has received the cooperation of this division during the past year in efforts directed toward the eradication of the destructive grasshopper. A fungus isolated from a number of grasshoppers that were found diseased in the vicinity of Sterling, Colo., has been distributed in subcultures to the farmers in the infected districts, together with other locust fungi which the Division of Entomology obtained from South Africa. These molds have been kept alive in this laboratory, subcultures being furnished the Division of Entomology on request. During the past year over 780 tubes of fungi have been sent to 17 States in this country and some to several foreign countries.

EXPERIMENTS WITH PREVENTIVES FOR ANTHRAX.

Anthrax seems to be on the gradual increase in this country, and it would appear desirable for the Bureau to meet the great demand which has been constantly made by the cattle owners in the infected

districts for a preventive against the disease. Anthrax vaccination has been adopted to some extent in certain districts, but in a more or less desultory manner, and the fact that it has not become more popular is probably due to the questionable efficiency of these vaccines. In order to test the relative value of both an active and a passive vaccine, various experiments have been conducted in the laboratory with attenuated bacilli cultures prepared after the method of Pasteur, and also with the serum of previously immunized animals following Sobernheim's and Sclavo's experiments. The comparatively small amount of vaccinal product obtained by the latter methods, the uncertain results which followed when virulent cultures were inoculated into animals that had been treated with the serum, and the necessity for meeting a large demand, should anthrax vaccine be distributed, have shown conclusively that Pasteur's method is preferable, even though it is necessary to handle the organism of anthrax by this method. These experiments have not been concluded, but it is believed that it will be possible without any great expense to meet the demand for this preventive treatment of anthrax by the beginning of the next anthrax season.

Owing to the susceptibility of man to this disease and the extreme care with which any active vaccine, the organism of which is virulent for man, must be handled, it would seem desirable to cooperate with the experiment station veterinarians, State and assistant veterinarians, or other State sanitary officers rather than to distribute the vaccine directly to the stock owner.

PATHOLOGICAL EXHIBIT.

Considerable time was devoted to the preparation, installation, and supervision of an exhibit at the Pan-American Exposition at Buffalo, N. Y., and the South Carolina Interstate and West Indian Exposition, at Charleston, S. C., representing the line of work of this laboratory and its practical application, especially to meat inspection and the preparation of blackleg vaccine.

DIAGNOSIS OF SPECIMENS AND ANSWERS TO INQUIRIES.

The amount of time that is required for this manner of work has been very great, and, while it does not appear to any great advantage in a report of this nature, it has many beneficial results in disseminating important knowledge, and is greatly appreciated by those directly interested. During the past year there were 40,886 pieces of mail sent out by the division with reference to the distribution of blackleg vaccine.

ZOOLOGICAL DIVISION.

PUBLICATION OF THE CARD CATALOGUE.

Owing to repeated requests from various sources, and also to the risk of fire in the laboratory building, it was decided to undertake the publication of our card catalogue, which has been so long in preparation and which is invaluable. This has involved a great amount of work in verifying references which were copied from various authors and in making the abbreviations and style uniform. The "A" authors have already been issued, the "B" authors are in press, and the remaining authors are about ready for publication.

CONTINUATION OF EXPERIMENTS IN TREATING CATTLE, SHEEP, AND GOATS FOR ROUND WORMS.

The experiments in this line have been highly successful, and the results of the work have already been published. The treatment with a 1 per cent solution of coal-tar creosote has been found to be the most satisfactory of any of the methods tried in cases of infection with free nematodes in the fourth stomach. This method entails only one-fourth to one-ninth the manual labor that is required when the gasoline treatment is used, and it seems to involve less risk of accident to the animals. The medicine itself, when made up in large quantities, costs less than one-half cent per dose. A recent letter from Dr. Peters, of the Nebraska experiment station, states that upon reading the Bureau's account of this method of treatment, he tested the same for round worms in hogs and that it excels any other method known to him. The best results, in case of infection with free round worms below the stomach, were obtained by combined doses of creosote and thymol. No success was obtained in attempting to treat cases of infection with round worms encysted in the wall of the stomach or the intestine. All experiments with the most approved methods (intratracheal injections) of treating verminous bronchitis were also negative.

SURRA.

Owing to the diagnosis of surra among the army horses and mules in the Philippines, the zoological laboratory was suddenly called upon for an emergency report on this disease. An extensive report has been prepared and issued, and it is hoped that its contents will enable the prompt recognition of this disease should it appear in the United States.

HOOK-WORM DISEASE IN MAN.

Persons such as miners, excavators, farmers, etc., whose daily work brings them in contact with moist dirt, are subject, in Europe, Asia, Africa, South America, and Central America, to a disease known under the various names of uncinariasis, anchylostomiasis, brick-maker's disease, etc. A few cases of this malady have been reported for the United States, but it has been assumed that such cases were imported directly or indirectly from Europe. During this last year, however, we have been able to prove that this malady, as it occurs in the United States, is due to two distinct parasites. One of these is the Old World hook worm (*Uncinaria duodenalis*), so common in Italy and Africa, and the other is an endemic New World form, which Dr. Stiles, zoologist of the Bureau, has named *Uncinaria americana*. This disease is an important one from the agricultural standpoint because of its frequency in farm hands in certain countries, and the indications are that it is much more common in this country than has heretofore been supposed.

At the request of Dr. Walter Wyman, Surgeon-General of the United States Public Health and Marine-Hospital Service, the zoological laboratory has prepared an article upon this disease, giving an account of the structure and life history of the parasite, together with a discussion of symptoms, treatment, prevention, etc.

MISCELLANEOUS WORK.

The zoological laboratory has been called upon for the determination of a number of parasites of various kinds which have been sent in by farmers, veterinarians, physicians, boards of health, etc., and has issued several publications describing some of the forms in question. The zoologist was also detailed to the United States Army Medical School, at the request of Surgeon-General Sternberg, to give a course of instruction in medical zoology to the newly appointed medical officers.

DETAILS TO SCIENTIFIC MEETINGS.

The zoologist was also detailed to represent the Department of Agriculture at the international zoological congress held in Berlin, Germany, in 1901, and has continued to serve on the international commission on zoological nomenclature.

THE BUREAU EXPERIMENT STATION.

During the year ended June 30, 1902, the station was compelled to give so much time to the work required of it by the several laboratories of the Bureau that practically no independent investigations of importance could be undertaken. This is true not only with respect to time, but also with regard to the space and facilities for properly handling experiments concerning a variety of infectious diseases.

In addition to testing a number of supposedly pathogenic germs on cattle, donkeys, hogs, sheep, and smaller experiment animals, investigations concerning the following diseases were conducted during the year: Hog cholera, swine plague, tuberculosis, tetanus, rabies, anthrax, Texas fever, foot rot of sheep, an infectious disease of horses resembling and probably identical with maladie du coït, and a number of affections of minor importance. Other work conducted by the experiment station was the growing of several varieties of cattle ticks; experiments with drugs for the removal of internal parasites from domestic animals; the production of antitoxic sera for the treatment of swine plague, hog cholera, tuberculosis, and tetanus; the care and protection from exposure to disease of animals for producing normal sera, and the breeding and rearing of numerous small experiment animals for the use of the Bureau laboratories.

MISCELLANEOUS DIVISION.

QUARANTINES.

The work of the quarantine stations during the past fiscal year shows a marked increase over that of the preceding year, more than double the number of cattle having passed through the various quarantine stations.

Quarantine station for the port of Baltimore.—Necessary repairs were made on the buildings, fences, water-supply apparatus, and loading and unloading chutes for this station, located at Halethorp, Md., where 227 head of Hereford cattle were comfortably quarantined.

Quarantine station for the port of New York.—The property at Garfield, N. J., which has been leased by the Government and maintained as a quarantine station for the port of New York since 1883, was vacated September 30, 1901. The transfer to the new station, having been in progress during the summer, was completed at this time.

The active work of establishing the new quarantine station for the port of New York was begun April 1, 1901. Successful negotiations for a very desirable tract of land at Athenia, N. J., in the foothills of the Orange Mountains, 12 miles in a direct line from New York, were conducted by the Bureau of Animal Industry, and the ground was purchased in six parcels from as many separate owners, at a price that was considered very reasonable for land so favorably located in that section.

Immediately after the preliminaries of plotting the ground, laying out the streets, and locating the buildings, the erection of six stables was begun and rapidly pushed to completion. These are of a substantial character and attractive design, constructed of brick, with bluestone trimmings, with front and rear entrances sufficiently wide to admit of the passage through them of a horse and cart, and have been built with a view to securing every possible advantage in the way of sanitation and hygiene. Four of them accommodate 11 cattle each and two 17 each. In addition, during the first half of the fiscal year substantial stone foundations, with cement floors for three larger buildings, were erected and temporary stables moved from the old station were placed on them, one having a capacity of 80 head of cattle, the other two 22 each. To these accommodations there were also added six frame stables, which were likewise removed from the old station, giving an additional capacity of 208 cattle.

At the close of the fiscal year it is found that cattle, sheep, and hogs in quarantine here, together with those for which permits have been issued, will occupy all of the available space; and it is the purpose of the Department to erect permanent structures of brick and stone of the same design as the first six stables, and of varying capacities, in order to accommodate both large and small importations, until this station shall afford ample room and proper facilities for quarantining all animals of the class requiring quarantine that shippers may desire to enter at the port of New York, and until permanent brick and stone stables shall have supplanted the old frame barns brought over from Garfield and put up to meet the immediate needs of the station.

The above 15 buildings have an aggregate capacity of 410 cattle when the box stalls are used for large bulls or single animals. They might, under certain conditions, as when two or more small cattle could be placed in a box stall, accommodate 425 cattle.

The Department has expended thus far for land, buildings, and improvements, including an adequate water system for all purposes, about $61,000; and the appropriation by Congress, available July 1, will admit of the further erection of buildings and the continuance of improvements.

Quarantine station for the port of Boston.—This station is favorably located in a beautiful section of country at Littleton, Mass., and has received such attention, repairs, and improvements as were required to make it a desirable quarantine station, and, like the station at Baltimore, offers to importers advantages that are liable to be overlooked simply through the fact of a lesser prominence and popularity as a port of entry when compared with New York.

Animals quarantined.—The animals enumerated have all been subjected to inspection and quarantine, the length of the quarantine period being fixed in accordance with the requirements for the subdivision of the class to which they belong. The imports of animals

from Canada not subject to quarantine at quarantine stations comprised 27,716 cattle, 148,313 sheep, 3,305 horses, 5,356 hogs, 2 dogs, 5 goats, 1 mule, and 2 moose—total, 184,700.

The following table shows the number and kinds of animals detained in quarantine for the requisite time:

Station.	Cattle.	Sheep.	Hogs.
Littleton, Mass	60	42	
Garfield, N. J	62	8	5
Athenia, N. J	588	118	7
Halethorp, Md	227		
Port Huron, Mich	22		
Detroit, Mich	2	2	1
Sault Ste. Marie, Mich	2		
Ogdensburg, N. Y	1		
Hogansburg, N. Y	6		
Alexandria Bay, N. Y	4		
Cape Vincent, N. Y	2		
Buffalo, N. Y	49		
Charlotte, N. Y	2		
Richford, Vt	8	2	5
Newport, Vt	19	8	
Island Pond, Vt	1	5	3
Beecher Falls, Vt	101	1	
Houlton, Me	45	39	4
Vanceboro, Me	4		
Calais, Me	4	6	1
San Francisco, Cal	5		7
Total	1,214	231	33

There was also imported through the port of New York and quarantined, under the supervision of the superintendent of the Athenia, N. J., quarantine station, the following: Forty-six deer, 5 aoudads, 1 yak, 2 elephants from India, 2 wart hogs, 43 camels, 9 antelopes, 6 goats, 1 horned horse, 4 llamas, 2 alpacas, 1 wild boar, 1 chamois, 2 guanacos, 1 anoa, 7 caribou—total, 133 animals; through the port of Boston, Mass., and quarantined under the supervision of the superintendent of the quarantine station at Littleton, Mass., 6 deer, 1 camel, and 1 llama—total, 8 animals; at Philadelphia, Pa., and quarantined under the supervision of the inspector in charge for that port, where a special temporary quarantine was established for the purpose, 9 deer, 2 wart hogs, 6 camels, 1 horned horse, 1 water buffalo, and 1 thar—total, 20 animals; Detroit, Mich., 1 goat; San Francisco, Cal., 7 llamas. This makes a total of 1,649 imported animals that were quarantined.

The official veterinarian stationed at London, England, in accordance with the requirements of Bureau of Animal Industry Order No. 79, under date of November 10, 1900, which provides for the testing with tuberculin by an inspector of this Bureau of all cattle over 6 months old which are to be imported into the United States, has tested of the different breeds of purebred cattle in various parts of Great Britain, 1,067 cattle, of which 139 reacted and 928 passed, as follows:

Breed.	Passed.	Rejected.	Breed.	Passed.	Rejected.
Shorthorn	84	27	Hereford	294	15
Jersey	191	1	Galloway	1	
Aberdeen Angus	186	73	Dexter Kerry	15	
Ayrshire	25	8			
Guernsey	79	11	Total	928	139
Red poll	53	4			

In Canada the veterinarians of this Department tested with tuberculin 382 cattle, of which 355 passed and 27 reacted, as follows:

Breed.	Passed.	Rejected.	Breed.	Passed.	Rejected.
Aberdeen Angus	3		Ayrshire	17	6
Jersey	24		Durham	4	
Hereford	26	1	Grades	84	
Shorthorn	188	20			
Holstein	9		Total	355	27

A VENEREAL DISEASE OF HORSES.

The work which the Bureau has been carrying on for the purpose of eradicating an infectious venereal disease of horses, which work has been continued throughout the year, has not given those results that it was hoped would be secured. The semiwild condition of much of the country over which the disease had spread, as comprised in the Rosebud and Pine Ridge Indian reservations, South Dakota, and other parts of South Dakota, Nebraska, and Wyoming, together with the prejudices and the lack of cooperation and aid that should have been given by the owners and others whose interests were to be served, proved serious hindrances.

Another obstacle consists in the methods of certain horse traders, who commence at the northwestern corner of the State of Nebraska with a mixed lot of horses, many of which are very inferior, and trade all the way across the State to the Missouri River, frequently giving two horses for one, thus leaving behind such animals as might have shown indications of disease or of being unsound, so that they would reach the Missouri River with a greatly improved band of horses, and possibly scatter a number that were diseased along the route, as they aim to get rid of all suspicious animals before reaching the eastern border of the State.

Three diseased mares and one stallion have been shipped in from the Pine Ridge Indian Reservation to the experiment station of the Bureau, located at Bethesda, Md., for the purpose of giving opportunity for a closer clinical study of the disease and for procuring fresh material for laboratory investigation. The work in this connection has been of an encouraging character, but, owing to the fact that the stallion's condition rendered him valueless except for post-mortem work, this specimen of the disease was unsatisfactory. However, valuable progress has been made and work in these lines is being continued, and it is hoped that both the investigation as to the causative agent and its life history, as well as the attempt of the Bureau to stamp out the disease, will, as a result of broader and more aggressive operations, which are in contemplation for the early fall, soon meet with success.

During the year 10 diseased stallions were purchased and slaughtered at an average cost of $25 each, or $250; 29 diseased stallions were castrated, and 76 diseased mares were purchased and slaughtered at an average cost of about $18.35, or $1,395, making a total of $1,645. Seven diseased mares were slaughtered, owners unknown, for which nothing was paid. At the close of the fiscal year, 15 diseased mares are held in quarantine to be disposed of.

MISCELLANEOUS WORK.

In addition to the work in connection with the animal quarantines as above, this division has a general supervision of the accounts and other work of the Bureau of Animal Industry as follows: Salaries, reimbursement of expenses incurred by its officers and employees in travel and at various stations; apparatus and supplies for the various divisions, their laboratories, the experiment station, and quarantine stations; all accounts of every character that are paid from the appropriation for the Bureau of Animal Industry; the preparation of an itemized report to each Congress, showing in detail the character of expenditures and the use of the appropriation; the making out of all appointments, transfers, promotions, furloughs, reinstatements, resignations, and dismissals; the making of requisitions and securing of informal bids for all materials and supplies used throughout the work of the Bureau, and the necessary letter writing incident thereto. The division also has charge of the preparation of replies to numerous letters requesting information in regard to the diseases of animals and poultry, their causes and treatment, and various other matters pertaining to breeds, breeding, and care of domesticated animals and allied subjects. This is the character of the routine work performed each year.

DAIRY DIVISION.

The work of the dairy division during the fiscal year ending June 30, 1902, has resembled that of previous years so closely that it can be largely reported in the language formerly used.

A general survey of the condition of the dairy industry of the country at large was begun upon the organization of the division. This has been continued and special inquiries have been made, such as the status of dairy organizations, dairy schools and facilities for technical instruction, State dairy laws, the development of foreign markets for the dairy products of this country, the milk supply of cities and towns and laws and ordinances relating thereto. Some reports have been printed and others are in course of preparation.

As heretofore, attention is given to the collection of dairy data in general, with a view to their proper arrangement and future use. So far as the clerical force of the office permits, the material collected has been indexed for ready reference. Although necessarily much in arrears, this catalogue of dairy information is of great value and in constant use.

The routine work of the office continues to increase and has become so great as to be managed with some difficulty, even with the increased clerical force provided. This routine embraces general correspondence, with many requests for specific information from all parts of the country, preparing instructions for the dairy inspectors in the field and attention to their reports, and the preparation of reports and other manuscripts for publication. During this year the division has prepared four distinct publications for distribution and nearly completed two others, the publication of which is necessarily somewhat delayed. These, collectively, comprise about 200 printed pages, nearly three-fourths of which first appeared in the annual report of the Bureau, and were separately reprinted. All have been liberally illustrated from original photographs obtained for the division or made by its officers.

Dairy centers in fifteen different States have been visited during the year by the chief or assistant chief of the division, and conventions of dairy associations and similar bodies have been attended in ten States. A special agent of the Bureau, on duty for this division, visited Japan, China, and the Philippines for the purpose of investigating market conditions and arranging for a series of experimental exports of dairy products from this country. Another special agent examined the conditions along the Canadian border with reference to dairy products crossing the line in the course of exports. A third special agent made an investigation into the manufacture of certain kinds of cheese in Belgium and Holland.

Experimental exports of dairy products have been made to Japan, China, Cuba, and Porto Rico. This method of making known the better grades of these products has resulted in somewhat increased sales by merchants in San Francisco and New York, and some parties elsewhere, but inadequate or unsuitable transportation facilities, the destructive climates of some of the countries referred to, and other unfavorable conditions prevent any rapid increase in this trade. Japanese markets may well be further cultivated from the Pacific coast, but in China, aside from condensed milk, the fresh supplies from Australia possess advantages with which shipments from this country can not successfully compete. Inquiry by correspondence indicates that there are good opportunities for finding markets for dairy products from the United States in Mexico and South America, if proper exertions are made in that direction.

Commencing with this fiscal year, and in accordance with an act of Congress approved March 2, 1901, a system was inaugurated for inspecting dairy products offered for export, affixing stamps to the same, and certifying to the character and quality of the articles. The law states the object to be "ascertaining the purity and quality of such products" and "to secure their identity and make known in the markets of foreign countries to which they may be sent from the United States their purity, quality, and grade." Although the authority granted may cover all dairy exports, it has been deemed expedient, at least for the present, to confine the certification to products which special inspection shows to be "pure, of high quality, and suitable for export." Special agents were accordingly appointed and placed on duty as "inspectors of dairy exports" at the ports of Boston, New York, and San Francisco, and also at Chicago. This service has been occasional only, or more or less continuous, according to the needs of the respective localities. During this fiscal year the relations of foreign markets to those of the United States have been rather abnormal, prices being such in this country as to prevent any considerable export of high-grade goods other than condensed milk and cream. While the service of these inspectors has therefore resulted in obtaining full information as to the character of our dairy export trade and the circumstances attending it, there have been few inspections requested by exporters and still fewer certificates given.

At the request of the Secretary of the Navy, this Department has assisted in perfecting specifications and arranging for the execution of contracts for securing an improved supply of butter for the Navy. Inspectors representing this division have been stationed at the places of manufacture, and have seen that only butter of extra quality has been packed and delivered under these contracts. The result has been that the butter in naval stores has been of a higher average quality

than ever before, while the cost of the same has been relatively low—a decided saving over the system of previous years.

Incident to the experimental exports and the inspection service noted, a large number of chemical analyses of milk, condensed milk, and cream, butter, and cheese have been necessary. This work has been accomplished by the dairy laboratory of the biochemic division of this Bureau, where a chemist and laboratory assistant have been kept constantly employed. In this connection special studies have been made of the products of nearly all dairy countries of the world, as found in many foreign markets. Experimental studies have also been made of the essential differences between (natural) butter, renovated butter, and butterine or oleomargarine, and the most practical methods of distinguishing or identifying these different articles.

At the Pan-American Exposition at Buffalo the dairy division contributed a portion of the exhibit of this Bureau and provided for its arrangement. Later, the same exhibit was made at the Charleston Exposition.

The act of Congress approved May 9, 1902, by its section 5 (and incidentally under section 4), places certain specific and important duties upon the Secretary of Agriculture, relating to the manufacture, interstate commerce, and export of "renovated butter," and the details of administration have been assigned to the dairy division. The work resulting from this action will be noted later.

Disconnected officially with this office, and yet closely related to it, has been certain work performed during the year in connection with the Twelfth United States Census. The chief of this division received from the Director of the Census, early in the year 1900, an appointment as expert special agent (without compensation) in charge of the statistics of butter, cheese, and condensed-milk factories. Advisory and supervisory duties were performed accordingly, from time to time, ending with the preparation of a report upon the establishments of the class indicated, and the data obtained from them, in the division of manufactures, which was published in June, as Census Bulletin No. 189. This office was also frequently consulted by the agricultural division of the Census, as to editing the dairy data collected from farms.

The work of the dairy division during the fiscal year 1902–1903 will embrace, in large measure, a continuation of that of previous years and also include several material additions.

The condition of the dairy industry in the United States will be studied in all its aspects, with a view to determining the most favorable opportunities for progress and improvements and assisting in their accomplishment so far as practicable. The dairying of other countries must also be observed, productive conditions noted, the demands of consumption and of all foreign markets watched, and such action taken as is possible in the interest of extending foreign trade in dairy products. Relations will be maintained with State dairy officials, with the voluntary organizations of dairymen, and with the dairy schools in numerous States, in order to be informed of their proceedings and cooperate with them so far as may be advisable. The investigations of the agricultural experiment stations along dairy lines will be closely watched and facts collected which may be usefully disseminated.

This division will conduct investigations by itself or in cooperation with suitable agencies. It is proposed in particular to study the meth-

ods of preparation, chemical composition, and keeping quality of creamery butter, and special methods of preparing and packing butter for export to warm climates; also to test the recommended methods of curing cheese at low temperature.

The very important subject of municipal milk supply needs further attention, and the preparation of a special report upon it is intended.

Other reports are also in preparation and proposed. Among them will be a compilation of dairy statistics of this and other countries, and the latest available.

The inspection of dairy products exported from this country, which has been largely experimental during the past year, is expected to assume a systematic condition during the present one. Much depends, however, upon the dairy markets at home and abroad and the commercial conditions which influence the export trade.

Inspection of the manufacture and interstate commerce of renovated butter will be begun at once under act approved May 9, 1902, going into effect July 1, 1902. In this connection it is proposed to make special exertions to have all renovated butter hereafter exported from this country so thoroughly stamped, marked, and labeled as to insure its commercial identity and make known its true name and character to buyers and consumers, so long as the merchandise is within the jurisdiction of the United States; also to inform the principal importers of foreign countries, and of Great Britain in particular, in regard to the law and the action thereunder by this Department.

REPORT OF THE CHIEF OF THE BUREAU OF PLANT INDUSTRY.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Washington, D. C., September 24, 1902.

Sir: I have the honor to submit herewith a report giving an outline of some of the more important operations of the Bureau of Plant Industry for the fiscal year 1901–1902.

Respectfully,

B. T. Galloway, *Chief.*

Hon. James Wilson, *Secretary.*

SUMMARIZED STATEMENT OF THE YEAR'S WORK.

Some of the more important matters which have come before the Bureau since the last report was issued may be briefly summarized as follows:

The Agrostologist, Prof. F. Lamson-Scribner, resigned to accept the position of chief of the insular bureau of agriculture in the Philippines, and Prof. W. J. Spillman, of the Washington Agricultural College, was put in charge of the grass and forage plant work. The Physiologist and Pathologist, Mr. Albert F. Woods, was, by authority of Congress, made chief of Bureau in the absence of the chief. Dr. B. M. Duggar severed his connection with the Department to take the chair of botany in the Missouri State University. Professor Scribner and Dr. Duggar were made collaborators of the Bureau.

Four additional lines of plant work, namely, the Arlington Experimental Farm, tea cultural investigations, purchase and distribution of valuable seeds and plants, and the investigations of domestic sugar production, were, by authority of Congress, brought within the Bureau. Cooperation in various lines of work was effected with 30 experiment stations. Plan for effective work on farm management put into operation. Demonstration experiments to show the practical value of a number of lines of work were inaugurated in 20 States and Territories. Agricultural explorations were continued in India, China, Japan, and other countries. Twenty bulletins, 7 miscellaneous papers, and 6 Farmers' Bulletins were issued. One hundred and seventy-five thousand letters were received and answered. Diseases of the sugar beet, cotton, cranberry, apple, pear, and peach received special attention. Encouraging results in the treatment of bitter rot of the apple and pear blight were obtained. Plant-breeding work on corn, cotton, and cereals gave encouraging results. A number of the new hybrid cottons secured are more valuable than existing forms. Investigations of alkali-resistant plants inaugurated, and breeding and selection experiments begun to develop plants adapted to alkali soils. The macaroni wheat industry established, 1,500,000 bushels being grown as a result of the work of the previous year in the distribution of seed

and general encouragement of the industry. Encouraging results in the use of macaroni wheat by factories secured. Hard Russian wheats proved successful in a number of western States where other hardy varieties had failed. A new and simple method of rapidly propagating and distributing nitrifying organisms discovered, making it practicable to materially improve cultivation of leguminous crops. The value of American-grown clover seed over the European product demonstrated. New method of cleaning and handling grass seed discovered, materially increasing the value of the crop. Investigations of drug and medicinal plants inaugurated, to determine the practicability of growing plants which are now largely imported. Increased facilities for the study of western ranges and their improvement secured. Investigations inaugurated to secure substitutes for red clover. Extended experiments inaugurated to develop the possibilities of alfalfa culture in the Eastern United States and in the South. A number of successful experiments in the shipment of American fruits to foreign countries made. Peaches shipped from Georgia and Connecticut to London markets yield handsome profit. Pears and apples also successfully shipped. Experiments to determine the best methods of handling, wrapping, and shipping such fruits gave encouraging results. Extensive experiments inaugurated to determine best methods of fruit storage. Methods discovered whereby the injury through "scald" in storage may be materially lessened. Varietal tests of apples to determine their relative storage value made. Viticultural investigations inaugurated, having for their object the encouragement of grape culture in all parts of the country, special studies of resistant stocks being made. Experiments in the methods of bench and field grafting Vinifera grapes inaugurated. Experimental vineyards established in North Carolina and other Southern States gave interesting results. Simple method for rapidly cultivating the pecan and other nut trees discovered. Work of gardens and grounds reorganized and placed in charge of the Horticulturist. New glass houses constructed and facilities for advanced horticultural work secured. Arlington Farm surveyed, drainage work continued, and experimental investigations in a number of lines inaugurated. New facts in regard to commercial tea culture secured and improvements made in the general methods of cultivation, pruning, and handling the product. Nine thousand pounds of commercial tea produced, most of which ranks with the high-grade imported kinds. The work of securing and distributing seeds and plants reorganized. New cereals, including wheats, oats, rye, and barley introduced and distributed. New varieties of rice secured and distributed in the rice-growing sections of Texas and Louisiana. A shipment of 225 date trees secured from Persia and planted in the experimental date orchard in Arizona. The date orchard now comprises 11 acres and contains 580 imported trees, besides 80 native seedlings, all doing well. Successful introduction of Egyptian clover, or berseem, from Egypt. Successful introduction of the Jordan almond. Successful introduction of a number of alkali-resistant alfalfas and cottons.

Under the accompanying heads some of the more important details connected with the foregoing synopsis are given.

WORK OF THE YEAR.

In accordance with the recommendations made by you in your last report and submitted in your estimates, the several lines of plant

work affiliated under this Bureau by Executive order were brought together by authority of Congress. The work of the Bureau, therefore, is now conducted by the following offices:

(1) Vegetable Pathological and Physiological Investigations.
(2) Botanical Investigations and Experiments.
(3) Pomological Investigations.
(4) Grass and Forage Plant Investigations.
(5) Experimental Gardens and Grounds.
(6) Arlington Experimental Farm.
(7) Tea-culture investigations.
(8) Purchase and distribution of valuable seeds.
(9) Investigating production of domestic sugar.

There have been but few changes in the organization since my last report. Acting upon your recommendation to Congress, the Plant Pathologist and Physiologist, in charge of the investigations in pathology and physiology, was, by act of Congress, authorized to act as chief of Bureau in the absence of the chief. Early in the year Prof. F. Lamson-Scribner severed his connection as Agrostologist of the Department to accept a position as chief of the insular bureau of agriculture in the Philippines. Professor Scribner was made a collaborator of this Department, and is organizing his work in such a way as to bring about a close relationship between agricultural researches in this country and in the Philippines. Prof. W. J. Spillman, of the Washington Agricultural College, was made Agrostologist of the Department and entered upon his duties January 1, 1902. Near the close of the fiscal year Dr. B. M. Duggar, Physiologist, resigned his position to accept the chair of botany in the Missouri State University. Dr. Duggar has been made a collaborator of the Bureau and will continue important investigations in connection with the Department. Owing to the increased work of the Bureau, a number of new assistants were secured for various lines of investigation. In most cases these have been appointed from the registers prepared by the Civil Service Commission from examinations held to fill such places. In addition to the assistants thus engaged, a number of scientific aids and student assistants have been brought into the Bureau and have been assigned to important investigations connected with research work. The scientific aids are proving a valuable addition to the Bureau workers, and as time goes on will eventually become the chief source for recruiting our workers, as the older men are called away by offers elsewhere.

ENCOURAGEMENT OF ADVANCED WORK IN THE BUREAU.

Since the reorganization of the Bureau the policy has been to encourage the most advanced work by placing the responsibility for different lines of investigation and research directly upon the men themselves. It is believed that the best results can be obtained always by assigning men to different lines of work and making them feel the responsibility for its advancement. Wherever this policy is carried out there is a worthy ambition to advance in all directions, and as a result the Bureau, as a whole, feels an impetus which can be given in no other way. In all cases the investigators in the different lines are encouraged to make their work as thoroughly practical as possible. It is of course recognized that no valuable practical work can be carried on

unless based on sound scientific principles. Hence the necessity for maintaining the proper relationship between careful scientific research and the practical application of such research.

COOPERATIVE WORK WITH EXPERIMENT STATIONS.

The importance of close cooperation with the experiment stations has been fully recognized by this Bureau, and for this reason a number of lines of important work have been entered upon which, it is believed, will be helpful to the Department and advantageous to the stations. There are many local questions connected with crop production with which the Department is not primarily concerned, but there are other questions of a broader nature which can not be bounded by State lines and which the Department can well look into and advance materially with the aid of station workers. It is such problems as these that are chiefly concerned in the matter of cooperation. In all such work it is recognized that there must be proper and harmonious arrangements between the officers of the stations and the officers of the Department. We have always held that no action in regard to cooperative work should be taken at the stations without first consulting the responsible officers, who are in touch with all the conditions which surround them and who are in a position to know the lines of work best suited to different officers under them. After preliminary arrangements are made with the officers of the station it has been our policy to have a definite understanding or agreement, in which the responsibilities of the Department and the responsibilities of the station are both shown. After such arrangements are entered into the matter of carrying out the details of the work may well be left to those who are directly interested in it. Under such arrangements the Department is now cooperating with the following stations along the lines briefly indicated:

Arizona.—The Agrostologist, Prof. W. J. Spillman, has under his direction cooperative work with this station in the study of the general subject of range improvement, particularly to ascertain the present condition of certain range areas with reference to vegetation, rainfall, surface erosion, amount and kind of stock carried and history of their management, and the amount of stock of various kinds that may be maintained on various parts of ranges without deterioration of the forage. There are also arrangements for testing various kinds of grasses and forage plants with reference to their value on the ranges. A large tract of land, covering something over 500 square miles, has been set aside for this work, and it is believed that excellent opportunities will be afforded here for solving important practical problems connected with range management. The director of the Arizona station has been made a collaborator of the Bureau, and will aid in managing the principal details of this work.

California.—In California the Agrostologist is directing cooperative experiments to determine the best methods for controlling or preventing the drifting of sand, and especially the planting and testing of sand-binding plants for this purpose. The subject of sand binders is an important one for the Pacific coast, and the cooperative work with the California station will be of great practical value in solving problems connected with this matter.

Colorado.—The Botanist in charge of Seed and Plant Introduction work, Mr. A. J. Pieters, has under his direction cooperative work

with this station looking to the determination of important questions connected with the growing of high-grade sugar-beet seed in the United States on a commercial scale. The work at this station is a part of a series of similar experiments which will be briefly referred to under the headings of the other States. The Agrostologist has under his direction experiments to determine the best grasses and forage plants for arid and alkali soils, and the best methods for maintaining permanent meadows and pastures.

Delaware.—The Agrostologist is conducting cooperative experiments with the Delaware station to determine what plants are most suitable for cover crops in orchards.

Illinois.—Cooperative work with this station is under way for the purpose of obtaining facts in regard to the production of sugar-beet seed and is carried on by the Botanist in charge of Seed and Plant Introduction work. The work at this station is largely confined to the comparative testing of seed of different origin. The fact that there is no beet-sugar factory within convenient distance makes it desirable to carry on work here on a commercial scale.

Iowa.—Under the direction of the Pathologist and Physiologist, Mr. Albert F. Woods, cooperative work with this station is being carried on chiefly in the line of cereal studies, the object being to obtain facts bearing on the improvement of cereals and the practicability of growing certain cereal crops in Iowa.

Kansas.—The Agrostologist is conducting experiments with this station to determine the best grasses and forage plants for arid lands, the value of these plants for hay and pasture, and the best methods of range improvement. The Pathologist and Physiologist is also cooperating with this station with a view to obtaining facts bearing on the production of cereals in the arid portions of the State, the testing of cereal varieties, and other work.

Kentucky.—The Agrostologist is conducting cooperative experiments with the Kentucky station, studying the rotation of crops in its relation to yield and farm management; studying and recording the morphological and physiological characters of grass and forage plants with relation to economic value; studying annual fodder crops with relation to yield and suitability for soiling and silage purposes; studying the methods of establishing and maintaining permanent meadows and pastures, and investigating the growing of commercial seeds and testing the value of seeds grown in different districts. This last work is under the direction of the Botanist in charge of the Seed and Plant Introduction work. The Botanist is conducting work to determine the value of clover seed obtained from different foreign countries and different parts of this country.

Louisiana.—Under the direction of the Botanist, Mr. Frederick V. Coville, there is being conducted at this station an experiment for the purpose of growing and studying several varieties of sweet potatoes, to determine their botanical characteristics and market value.

Maine.—The Botanist is conducting work to determine the value of clover seed obtained from different foreign countries and different parts of the United States.

Maryland.—The Agrostologist is conducting investigations for the purpose of finding the best crops for use in securing a continuous soiling series for dairy and farm stock, and the Botanist is cooperat-

ing upon variety testing of the sweet potato for the purpose of improving varieties. The Botanist is also conducting work to determine the value of clover seed obtained from different foreign countries and different parts of the United States, and the Pathologist and Physiologist is cooperating in cereal work.

Michigan.—The Agrostologist is conducting work for the purpose of determining the best methods for controlling or preventing the drifting of sand, and is testing sand-binding plants for this purpose. The Botanist in charge of Seed and Plant Introduction work is conducting investigations looking to the production of sugar-beet seed of high grade, this being a part of the same series of experiments carried on in a number of States. The Botanist is also conducting work at this station in the matter of testing the value of clover seed obtained from various sources.

Minnesota.—The Pathologist and Physiologist is cooperating with this station for the purpose of testing and growing the different varieties of cereals. Special attention is being given to the breeding of cereals and the growing of new varieties.

Missouri.—Under the direction of the Agrostologist cooperative experiments are being made to determine the best method for the formation and management of meadows and pastures. Work has also been inaugurated having for its object the determination of the best forage crop for beef production, and the best methods of feeding such crops. The Bureau of Animal Industry is also cooperating in this work. The Pathologist and Physiologist is also cooperating with this station in investigations to determine the best methods of combating bitter rot of the apple and other diseases of orchard fruits. Under the direction of the Botanist cooperative work for testing the value of clover seed obtained from different sources is also being conducted.

Nebraska.—The Agrostologist is conducting experiments to determine the best grasses and forage plants for meadows and pastures. There are also being tested the adaptability of recently introduced forage plants and the productive capacity of annual forage crops for hay. The Pathologist and Physiologist is directing cooperative investigations in the matter of plant-breeding work, especially corn, and in work on diseases of crops.

New Hampshire.—The Botanist is conducting work at this station in testing the value of clover seed obtained from various sources.

New Mexico.—The Agrostologist is conducting cooperative work to determine the best crops for supplying forage to supplement the ranges and for the improvement of cultivated lands.

North Carolina.—The Agrostologist is conducting investigations to determine the best grasses and forage plants for meadows and pastures, and the adaptability of recently introduced forage crops, and the Pathologist and Physiologist is directing cooperative work on grape diseases.

North Dakota.—The Pathologist and Physiologist is directing cooperative experiments with this station for the purpose of securing information regarding the production of cereals in the Northwest, and particularly the matter of obtaining new cereals by breeding. Work is also under way in the matter of determining the possibility of growing macaroni and other wheats in the State. The Botanist is

also conducting investigations to test the value of clover seed obtained from various sources.

New York.—Under the direction of the Botanist in charge of Seed and Plant Introduction, cooperative work on the growing of sugar-beet seed is under way at this station. A number of lots of imported seed have been planted, and comparative tests will be made to determine the relative value of the beets raised from the different lots of seed. Mother beets will also be selected and tested in order to raise seed from them next year.

Ohio.—Under the direction of the Botanist, cooperative work is being carried on at this station to test the value of clover seed obtained from various sources.

Oregon.—The Agrostologist is conducting cooperative work to determine the best methods for preventing and controlling the drifting of sand and the testing of sand-binding plants for this purpose. The Botanist also is carrying on investigations as to the value of clover seed obtained from various sources.

South Dakota.—Under the direction of the Pathologist and Physiologist, cereal investigations are being conducted at this station for the purpose of determining questions relating to breeding and the testing of new varieties. The Agrostologist also is conducting cooperative work at this station to determine the best grasses and forage plants for arid lands, the value of these plants for hay and pasture, and the best methods of renewing worn-out range and pasture lands.

Tennessee.—The Agrostologist is conducting at this station cooperative experiments looking to the development and distribution of better forage crops than those now grown in the State, especially with regard to yield, hardiness, resistance to drought, quality, etc.; also to determine the effect of change of environment on cultivated plants; to investigate the commercial production of seed; to investigate the problem of crop rotation and the use of fertilizers; to determine the value of various annual crops for hay, soiling, and silage purposes; to investigate the methods of establishing and maintaining permanent meadows and pastures, and to investigate the methods of making hay. The Pathologist and Physiologist is conducting experiments here in the matter of plant breeding and the improvement of crops in general. The Tennessee station is being made a central organization for work which will obtain facts of value to a number of adjacent States. The Botanist is conducting investigations also to test the value of clover seed obtained from various sources.

Texas.—The Pathologist and Physiologist is conducting cooperative investigations at this station for the purpose of determining important questions concerning the development of cereals and the adaptability of cereals to different parts of the Southwest. The Agrostologist is carrying on experiments to determine what grasses and forage plants are best for meadow and pasture purposes in Texas, the proper methods of establishing the same, and the value of annual forage plants for hay, pasture, and soiling.

Utah.—The Agrostologist is conducting experiments at this station to determine under varying amounts of water the value of certain grasses and forage plants for arid regions.

Vermont.—The Botanist is conducting experiments, in cooperation with this station, looking to the improvement and cultivation of certain

drug-producing plants, the object being to demonstrate the practicability of growing such plants in this country. The Agrostologist is conducting experiments to determine the best pasture and meadow grasses for wet lands.

Washington.—The Agrostologist is conducting experiments at this station to determine the best and most practical way of improving forage conditions in the dry sections of the Northwest, and for renewing the worn-out ranges and devising methods of managing them whereby the highest degree of productivity may be maintained. The Pathologist and Physiologist is directing investigations in the matter of improvement of cereals adapted to the Northwest. The Botanist is directing experiments in the improvement and cultivation of certain drug-producing plants, such as belladonna, aconite, digitalis, and opium poppy.

Wisconsin.—The Pathologist and Physiologist is conducting cooperative investigations with this station to determine the value of various cereals, and to obtain information connected with the breeding and improvement of the same.

Wyoming.—The Agrostologist is conducting investigations at this station to determine the best grasses and forage plants for arid and alkali soils, and the best methods of establishing and maintaining permanent meadows and pastures.

COOPERATION WITH OTHER BUREAUS IN THE DEPARTMENT.

In addition to extensive cooperation with experiment stations, this Bureau is also engaged in cooperative work with a number of other Bureaus in the Department. As stated in previous reports, cooperation with the Bureau of Soils has been mainly in the direction of investigations upon tobacco. Considerable attention has been given to the diseases of tobacco and problems relating to fermentation and curing of the leaf. Cooperation has also been carried on with this Bureau in studies of alkali problems, and a representative from each Bureau has been sent to Algeria and other countries to make a special study of the conditions there for the purpose of obtaining light on problems of importance in connection with questions in the arid and semiarid West. This work will be more fully referred to under "Foreign agricultural explorations." Cooperative work has been effected with the Bureau of Forestry in studies upon the decay of timber and allied subjects. The representative of this Bureau has been made an officer in the Bureau of Forestry, and is so conducting his investigations as to harmonize all lines of work where the work of the two Bureaus comes into close contact. The Bureau of Chemistry is cooperating with this Bureau in the matter of making special studies of fruits under the direction of the Pomologist, and is also aiding and assisting in work connected with the poisonous plant investigations and drug investigations and the work on cereals.

FARM MANAGEMENT.

Since the Bureau was organized the need has been felt for a proper coordination of the varied lines of work being carried on, and particularly the application of several lines of investigation in the matter of securing practical ends. With a view to making the work of the Bureau of more direct practical benefit to agriculture, arrangements

have been perfected for carrying on under one central authority a system of work which we have designated as "farm management." This work has been placed in the hands of Prof. W. J. Spillman, and so far only preliminary surveys and observations have been made for the purpose of inaugurating, as soon as opportunities offer, investigations and studies on a more extended scale. During the summer some special studies have been made of farming conditions in different parts of the country, and particular attention has been paid to the management of high-class farms. The questions pertaining to rotation of crops, handling of stock, and all such matters have been taken under consideration with a view to determining what steps have been followed and what the results have been in a practical way from operations carried on under the best systems. Some interesting results have been secured from these studies, as it has been shown that systems of farming in different parts of the country are largely the result of conditions of soil, climate, markets, etc., existing in the different regions. There has been developed, in other words, a system, through long experience, which has given the most practical results and the most profit under the existing surrounding conditions. It is planned, as soon as this work is put into full operation, to continue such special studies and to secure the cooperation of farmers in different sections, with a view to putting into operation systems of farm management that may be worked out by the officers of the Bureau. For example, it will be our object to lay out and plan the best methods of diversified farming in certain parts of the South, to suggest the kinds of crops that may be grown, methods of rotation, methods of controlling diseases, and, in short, all operations which will lead to the greatest profit with the least expenditure of time and money. The same general plan may be followed in connection with work on fruits and work on other crops as well. The question of securing proper statistical data in regard to operations of the most successful farmers will be continued, and this in large measure will form a basis for suggested work in improving conditions in other sections of the country. It is believed that work of this kind will be of great practical value, as it will enable the Bureau to put into operation suggestions that may be secured as the result of its extended scientific researches.

DEMONSTRATION EXPERIMENTS.

Closely allied with the foregoing class of work, the Bureau is putting into operation demonstration experiments in a number of directions in different parts of the country. The object of this work is to reach farmers and fruit growers in a direct way. Those who till the soil are, and must necessarily be, conservative, for a mistake means a loss not only of a crop but of a great deal of time as well. Hence suggestions in regard to improving agricultural conditions which may be given in publications, no matter how simple or plain these publications may be, are received with a great deal of conservatism by the great mass of those whom it is intended to benefit. The speculative or venturesome spirit in the farmer is fortunately largely lacking, and it is only here and there that some one with less fear of failure undertakes to put into operation improvements that may be suggested in the bulletins or other papers issued from time to time. Demonstration experiments, however, are intended to act as object lessons, and will go far toward convincing farmers of the utility or nonutility of

certain kinds of work. Such experiments have been inaugurated in many parts of the country during the past year, and have been used to show the value of different methods of controlling plant diseases, the value of forage crops, the value of new or little-known crops, the value of different methods of harvesting crops, etc. A special effort has been put forth to encourage the growth of alfalfa in different parts of the country, and to this end demonstration experiments have been inaugurated in ten or twelve States. Representative farmers have been selected in certain regions and have been supplied with sufficient seed to sow from 1 to 2 acres of this crop. Careful records have been kept by these men as to time of sowing, growth of crop, climatic conditions, etc., and the results obtained show that great interest has been taken in the work. A number of other crops have also been under consideration, and will be more specifically referred to under the reports of the executive officers.

FOREIGN AGRICULTURAL EXPLORATIONS.

During the year quite extensive foreign agricultural explorations have been carried on by the Bureau. Dr. Seaman A. Knapp was sent on a special mission to the Orient for the purpose of securing information, and seeds and plants of special value to the South. The particular object of this trip was to obtain further facts pertaining to rice culture, and to secure, if possible, new varieties of rice adapted to conditions in the States of Louisiana and Texas. The question of forage crops was also considered, and careful studies were made of these subjects in the Philippines, Japan, China, and India. Dr. Knapp returned to this country early in May, and brought with him the seed of a number of new crops which are being grown and tested in the South. Through the generosity of Hon. Barbour Lathrop, the Department has been able to secure much valuable information and a number of important introductions from foreign countries. Mr. Lathrop has taken a deep interest in this work and, at his own expense, has been making special studies in a number of foreign countries, assisted by Mr. D. G. Fairchild. Both Mr. Lathrop and Mr. Fairchild are working through the Department, but, as already indicated, the expenses are in the main borne by Mr. Lathrop. Since my last report these gentlemen have visited India, China, Japan, and a number of other foreign countries and, as already pointed out, have been instrumental in securing many valuable additions to our list of crop introductions. Late in the year Mr. Thomas H. Kearney, of this Bureau, and Mr. Thomas H. Means, of the Bureau of Soils, were sent to the arid and semiarid regions of Africa for the purpose of securing information upon alkali crops and alkali soils which would enable us to improve the agricultural conditions in the arid and semiarid regions of this country. Mr. Kearney is making a special study of the crops, while Mr. Means is studying soil conditions. These gentlemen will secure seeds and plants wherever practicable, and the soil studies made will undoubtedly be of great value in enabling us to formulate our plans in regard to the distribution of such things as may be obtained. Mr. Ernst A. Bessey has been sent to Russia, Turkestan, and adjacent countries, for the purpose of securing new forage crops, particularly Turkestan alfalfa, which was introduced into this country a few years ago, but which, unfortunately, has so far yielded no seed. Mr. Bessey will also secure a number of varieties of cereals adapted to the

dry regions of the Northwest, and will also aid the work of Seed and Plant Introduction by securing data which can be used in the future in the matter of ordering seeds which may prove of value for different parts of this country.

PUBLICATIONS.

The methods of preparing publications of the Bureau have been considerably simplified since my last report. During the year twenty bulletins were issued dealing with various topics; and in addition there have been published six Farmers' Bulletins, prepared by the officers or assistants in the Bureau. There were also prepared six Yearbook papers, all dealing with subjects pertaining to plant industrial work. Under the present system there is only one series of bulletins in the Bureau, and these deal for the most part with technical or semitechnical matter. The editions of these bulletins are more or less limited, and wherever the subject is one of direct practical importance Farmers' Bulletins giving the main facts and their practical application are prepared. The technical and semitechnical bulletins of the Bureau are sent for the most part to libraries, experiment station and college workers who are engaged in lines of work similar to those being carried on in the Bureau. With a view to the greatest economy in the distribution of these publications careful lists are kept, and only a limited number of libraries receive everything that is issued. The wide diversity of subjects handled by the Bureau makes it necessary to maintain separate lists, and in doing this arrangements are made to have the publications reach those who are most directly interested.

CORRESPONDENCE.

The correspondence of the Bureau grows from year to year and has now reached a magnitude little understood. The proper handling of this work involves probably not less than one-fourth the time of the entire Bureau force and deals with most varied subjects. It is, however, looked upon as a means of instruction of vast importance, and every effort is made to give careful consideration to the subjects brought up. Inquiries of most varied kinds are received, many of which are accompanied by specimens of various sorts, which require careful study before an intelligent answer can be given. Many of the inquiries are of such a nature that they can be handled by sending a Farmers' Bulletin or some other publication of the Bureau which contains the specific information sought. Many, however, require special letters, and in all such cases as full information as can be secured is given on the subjects involved. The entire correspondence of the Bureau will aggregate from 175,000 to 200,000 communications annually.

INCREASING CALLS FOR WORK.

Notwithstanding the somewhat rapid advances made in the last two or three years in the way of extending the work of the Bureau, the calls for additional assistance are still greatly in excess of our ability to meet them. A fact that is not generally appreciated is that as the struggle for life becomes more intense in this country, and the work connected with the production of crops becomes of a higher nature, the possibilities of injuries from diseases and the necessity for improvements in order to meet the keen competition existing will become

greater and greater. Owing to such facts, it is to be expected that the Department will have increasing calls for not only more work, but work of a higher type than has been the case heretofore. The appropriations made from year to year are not only needed to maintain the work inaugurated, but additional funds must be forthcoming to take up new questions as they arise. It has been suggested that a work, such as is being carried on by this Bureau and by the Department as a whole is of such a nature that certain lines of investigation can be finished or wound up, as is the case with manufacturing concerns. This is only partly true, for the production of crops can not properly be compared to a manufactured product. It follows, therefore, that funds for maintaining the work inaugurated must be at hand, and, in addition, new appropriations will become necessary to take up lines of work which present themselves as agricultural development advances.

REPORTS OF EXECUTIVE OFFICERS.

In the accompanying reports are set forth some of the main facts connected with the work of the different offices in the Bureau.

PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

The work connected with Pathological and Physiological Investigations, under Mr. A. F. Woods, has been pushed forward rapidly during the year. The main points covered may be briefly reviewed under the following heads:

PATHOLOGICAL WORK.

Diseases of the sugar beet.—The work on diseases of the sugar beet has been under the direct charge of Dr. C. O. Townsend, who has been making special studies of both the sugar-producing beets and mother beets used for seed. In the West the most serious disease has been the blight or curly top, while in the Middle and Eastern States the leaf spot has been the most serious pest. These two diseases have caused losses to the growers and to the manufacturers aggregating thousands of dollars. Investigation has shown that diseases of the sugar beet may result in producing a poor stand of beets in the field, either through the failure of the seeds to germinate or by a destruction of the seedlings. Experiments are now in progress looking to the control of the fungus pest and other unfavorable conditions affecting the sugar beet, and it is believed that practical remedies will be found in the near future which will enable the growers to prevent losses from these sources.

Diseases of cotton.—During the year work on the cotton-root rot in Texas has been continued by Dr. B. M. Duggar, and work on other diseases of cotton has been pushed with vigor by Mr. W. A. Orton.

There is yet much to be done in connection with the cotton-root rot diseases in Texas, and the work under way has for its object the determination of practical remedies for these troubles. The cotton wilt, a serious disease, is now pretty well controlled by means of proper handling of infected land and the use of resistant strains which have been developed by the Bureau. The Bureau has succeeded in securing the active cooperation of a number of progressive cotton growers in this important work, and very satisfactory results

have been obtained. The control of the wilt disease is, for the most part, applicable to the Sea-island districts. A more serious problem has been encountered in the control of the wilt disease in Upland cotton. The breeding of resistant varieties in Upland cotton has been under way for two years, but the work is more difficult than with the Sea-island cotton for the double reason that the Upland varieties are naturally less resistant to wilt than the Sea-island, and the planters are, as a rule, not willing to undertake such work alone. Extensive cooperative experiments have been inaugurated with cotton growers in a number of parts of the South for the purpose of encouraging the production of resistant strains and developing varieties having increased values in other directions.

Cranberry diseases.—In the last two or three years the cranberry crop has suffered serious loss from a number of very destructive diseases. The attention of the Bureau was called to this matter and an attempt is being made to determine, if possible, the means of checking these destructive maladies. This work has been under the direction of Mr. C. L. Shear, who is now engaged upon a special study of the diseases, and is also conducting experiments with a view to determining the most satisfactory methods of prevention. The cranberry crop for 1901 had a value estimated at about $2,000,000. The losses from the several fungus diseases to which the crop is subject will probably amount to about 20 per cent. The efforts that have been made in the direction of determining the causes of a number of diseases have been partially successful, and it is believed that with proper facilities at hand remedies can be secured.

Diseases of orchard fruits.—The study of diseases of orchard fruits has been carried on, under Mr. Woods's direction, by Mr. M. B. Waite, who has charge of this particular branch of pathological investigations. During the year extensive work was conducted in peach and plum orchards, with a view to the prevention of the rot fungus which attacks the fruit about the time of ripening. Some exceedingly interesting practical results have been obtained by sprayings with Bordeaux mixture, it being found that even in an unfavorable, rainy season the rot is greatly reduced by the proper application of this preparation. Special attention was given by Mr. Waite to the injurious effects of copper compounds on peach foliage, a subject which has long attracted attention, and under his direction satisfactory answers to many of the questions involved have been reached.

Work was also carried on by Mr. Waite on the "Little peach" disease, which has caused such serious losses in various parts of the country during the past three or four years. All observations that have been made seem to indicate that the prompt rooting out of diseased trees on the first symptoms of the disease serve to eradicate it, or at least keep it in check where it occurs. The disease is a very difficult one to control, as are, in fact, all such maladies. The principal hope of success seems to lie in prompt extermination. Possibly there may also be some results secured in the line of resistant stocks. At any rate, this branch of the work will be pushed as rapidly as possible. In the work on the treatment of bitter rot of the apple there have been some very satisfactory results obtained. The very serious nature of this disease has made it imperative to find, as soon as possible, some satisfactory remedy. The experiments last October were only partially successful on account of the failure of both the sprayed and unsprayed trees to fruit. The present year more careful experi-

ments have been inaugurated in various parts of Virginia, but as yet the results are not apparent. The demoralized condition of the pear orchards in the coast country of Texas made it imperative to undertake some work looking toward the prevention of pear blight in that region. Work was undertaken at Algoa in the matter of exterminating this disease by the practical application of principles already worked out. The remedial methods, in brief, consisted in cutting out the diseased wood under proper conditions and at proper times. The results obtained show that by far the larger part of the disease has been prevented, and have greatly encouraged the pear growers in that section. In addition to the foregoing work, Mr. Waite has under way a number of problems connected with pear pollination, and has also been pushing investigations in the matter of securing, by breeding, hybrid pears—crosses between the Orientals and such varieties as Seckel, Anjou, and other choice fruits. Several thousand seedlings have been obtained, the object being to secure, if possible, varieties having some of the vigor of the Orientals and some of the fruit-bearing qualities of such well-known sorts as the Seckel and Anjou.

PLANT-BREEDING WORK.

The plant-breeding laboratory is in charge of Dr. H. J. Webber, and he is endeavoring to increase the production of various crops and secure varieties of better quality and better adapted to various soil and climatic conditions. The work of amelioration and improvement of plants, though recognized as of the highest practical importance, has, until recently, been mainly conducted by seedsmen and planters, and has seldom been carried on systematically through a series of years. The following are some of the more important lines of work which have been taken up by this laboratory during the year:

Cotton.—The problem of the greatest interest in cotton improvement is the production of long staple Uplands. The long staple Upland varieties at present existing are all rather light producers, and are defective in that the fiber is borne on fuzzy or tufted seed, which makes them difficult to gin on a roller gin. A number of crosses were made in 1899 to bring about the production of an ideal Upland long staple, and the first generation hybrids were grown in the summer of 1900. Work is now under way fixing the types, and already promising results have been obtained. Aside from the work on hybridization of cottons for the purpose of securing new varieties, there is another important method of improvement, viz, the straight selection of standard races to secure more productive strains. Work of this kind was started last year in Mississippi with several standard sorts. The seed from the selections made then is being grown the present season to furnish seed for further selection, the aim being to obtain highly selected pedigree seed for distribution. The same method of selection is being applied to discover disease-resistant sorts, and already marked success has been accomplished along this line, as was outlined in my last report. We annually import about $6,500,000 worth of Egyptian cotton, and the present year quite extensive investigations were inaugurated for the purpose of determining where the standard Egyptian cottons would best succeed. The present season varieties of Egyptian cotton are being grown in fourteen 2-acre patches in Texas, New Mexico, Arizona, and southern California in order to test the value of this crop for general culture and furnish opportunity for conducting selec-

tion experiments to improve the quality and yield when grown under conditions prevailing in this country. In addition to the foregoing, 5-acre patches of Egyptian cotton are being grown in Georgia and Mississippi from seed grown in the same localities last year. This work is done in order to test production and furnish means of selection.

Corn.—The experiments in corn improvement have been mainly of a preliminary nature so far. The facts learned by the work in artificial pollination, selection, breeding of sorts, hybridization, and the study of immediate effect of pollen, have proved very valuable both from a scientific and economic point of view, and are of the greatest assistance in furnishing data for intelligently planning future work. The work of hybridization has furnished a number of valuable sorts, which are being grown for selection and fixation. One hybrid has been produced which gives the largest percentage of shelled corn of any sort which has thus far been tested. The corn industry has developed to such an extent that there is a growing demand for sorts adapted for special purposes. Corn oil is the most valuable of the constituent elements furnished by the grain, and this product exists mainly in the germ of the kernel. It would, therefore, seem desirable to breed a corn that will have a larger germ. Last year nearly 5,000,000 gallons of corn oil were exported and the demand is rapidly increasing; and a variety rich in this valuable product is becoming a great desideratum. The matter of handling seed corn is an important question, and in order to obtain information on this point 10-acre patches have been planted in five different localities, one-half of which was fire-dried and one-half air-dried seed, for the purpose of determining the profitableness of the kiln-dried corn used for seed purposes. Variety tests of field corns, table corns, and pop corns are in progress, and offer good opportunities for selection and breeding work.

Other breeding experiments.—A number of miscellaneous crops are receiving attention in the plant-breeding laboratory. Important results have been obtained in the matter of citrus improvement, and it is believed that the hybrids secured as a result of former work will bear fruit for the first time this season. It will then be possible to judge more definitely in regard to their value. Work on pineapple breeding has also been under way, and in addition there has been considerable attention given to the improvement of the guava, strawberry, and other crops. Aside from the direct practical investigations outlined above, the plant-breeding laboratory is endeavoring to make a thorough study of the general laws of plant breeding. It is highly important that we should know more about the methods of producing variations, and in what way and how soon such variations can be rendered hereditary. Experiments have been inaugurated in cooperation with several State stations in testing the influence of environment on certain crops, and the length of time necessary to grow crops under such environment to render the changed characters hereditary, if this ever occurs. Many other features, such as the prepotency of species in hybridization, the general laws of combination of characters in hybrids, and the immediate effect of pollen, etc., are being carefully studied.

ALKALI INVESTIGATIONS.

The office of Pathological and Physiological Investigations has taken up work, in cooperation with the Bureau of Soils, in problems con-

nected with the growth of crops in the alkaline soils which form so considerable a proportion of the irrigated area of the Western United States. This work is being carried on jointly by the plant-breeding laboratory and the physiological laboratory, under the direction of Mr. T. H. Kearney. The work has two principal objects in view: First, the securing by breeding and selection of alkali-resistant plants, and, second, physiological experiments for the purpose of obtaining facts of a scientific nature which will throw light on many problems connected with the effect of alkali on plant growth. At present the work is confined mainly to efforts in the matter of securing alkali-resistant crops of particular value to arid and semiarid regions. Alfalfa is receiving special attention. After a long search in different alfalfa-growing regions a small quantity of seed was obtained last summer from plants which showed themselves to be exceptionally resistant to alkaline soil. This seed is being used as a basis for further selections, although it is yet too soon to report on the outcome of the experiment. Experiments are also under way in the matter of securing resistant cottons, resistant cereals, and other resistant crops. In the case of the crops mentioned, the probable existence in other countries of varieties in which the quality of resistance has become fixed by cultivation in alkaline soils during many generations must be taken into consideration. The procuring of such varieties wherever they can be found and their adaptation to conditions here by selection, and possibly by crossing with varieties already growing in this country, is an important subject for investigation.

CEREAL INVESTIGATIONS.

This work falls chiefly in three lines: First, the establishment of introduced varieties of grain in cooperation with Congressional seed and plant introduction; second, the development of new varieties of wheat through breeding, cooperating with the plant-breeding laboratory; third, cooperative work with State experiment stations in field experiments with cereals. The investigations are in charge of Mr. M. A. Carleton, who has given special attention during the year to the following crops:

Macaroni wheat.—The continuation during the past year of the work already undertaken with macaroni wheats has now practically resulted in establishing the macaroni wheat industry in the Great Plains region of this country. In so far as the matter of production is concerned the problem is now pretty well settled. From the manufacturers' standpoint it will be necessary, however, to interest a few more millers in taking up the work of preparing this wheat for the macaroni factories. Encouraging results have been obtained in this direction, and a number of large mills in the Northwest have signified a desire to take up the work. The use of macaroni wheat will extend the wheat area much farther westward than before, over districts of great extent, even beyond the one hundredth meridian, where it was not considered possible to grow any wheat at all. On the basis of this great increase of yield per acre and of area devoted to wheat, it is a conservative statement to say that the entire average wheat production of the country is likely to be increased in the course of four or five years to from 30,000,000 to 50,000,000 bushels per annum, which, at average prices, would make an increase in money value to the wheat

crop of the country of fully $20,000,000 to $30,000,000. To show how quickly this increase is likely to come about, it may be said that the yield of macaroni wheat for last year, stating it very roughly, was about 75,000 bushels. On the basis of the amount of seed that is known to have been sown this season, the coming crop ought to furnish 1,500,000 or 2,000,000 bushels. This amount, however, will not be anywhere near sufficient to meet the demand for macaroni wheat from all quarters. Three or four of our own factories, which are anxious to obtain the wheat as soon as possible, would alone be able to consume nearly all of this amount. Already a new macaroni has been put on the market by one of our own factories, and four or five other factories for using durum wheat are contemplated. For the first time regular grades have been established for macaroni wheat by the Minnesota State inspection at Minneapolis. They now have all grades of macaroni wheat—Nos. 1 and 2 and Rejected.

Winter wheats.—Another problem which has been under consideration is the extension westward and northward of the winter wheat area. The establishment of a new crop is made on the basis of two lines of experiments: First, those made directly by the Department or in cooperation with State experiment stations, on a comparatively small scale, which indicate particular varieties that we are justified in experimenting with further; second, the trial of a few of the best of these varieties in much larger quantities, with the cooperation of interested farmers throughout the country. Experiments already made in half a dozen different States indicate that four or five of these winter varieties, obtained entirely from east and south Russia, are much more hardy than any varieties now grown in this country, and will admit of the extension of the winter wheat area several hundred miles farther north and some distance farther west than heretofore. On the strength of our experiments with these Russian varieties, 15,000 bushels of the Crimean wheat were imported last year by the millers of Oklahoma and Kansas, which wheat appears to have stood the severity of the winter better than the ordinary Turkey wheat.

PHYSIOLOGICAL LABORATORY.

The physiological laboratory, forming a part of the organization of the Vegetable Pathological and Physiological Investigations, is in charge of Dr. George T. Moore. The principal problems which have engaged the attention of the men in charge of this work are those connected with nitrogen accumulations in soils and the contamination of water supplies and cress beds by algæ. In connection with the nitrogen work the following important results have been secured: First, the discovery of the reasons for the failure and consequent abandonment of the German method of pure cultures; second, the discovery and perfection of a new, simple, cheap, and practical method of sending out pure cultures so that they will not spoil or deteriorate; third, the discovery and perfection of a means of rapidly and enormously increasing these cultures after they have come into possession of the farmer, thus making them much more valuable, while keeping the cost at a minimum; fourth, the reduction of the number of kinds of specific organisms required for various legumes, making it possible to cross inoculate garden peas with organisms from clover, lupine, pea, etc., which is of immense importance and a long step toward securing a universal organism good for all leguminous crops; fifth, the perfection

of a new method of growing the organisms which, instead of causing them to become weaker and weaker until they become a mere parasite, enables them to so increase in virility that they fix five times as much nitrogen as those normally found in nature. Extensive practical experiments were inaugurated to determine the foregoing facts, the work being carried on at the Arlington Farm, located near Washington, on the Flats, and in the Department greenhouses.

The great value of this nitrogen work can hardly be estimated. There are annually imported into the United States from 180,000 to 200,000 tons of nitrate of soda, with a value of from $5,000,000 to $6,000,000, an average of about $30 per ton. By careful and conservative estimates it can be shown that on every acre devoted to the growing of leguminous crops the tubercle organisms enable these plants to add from $8 to $10 per acre in nitrogenous fertilizer. In many cases the presence or absence of proper organisms is the element which decides the failure or success of the crop.

In the work on algæ the discovery and practical application of a method of preventing the contamination of cress beds may be noted. This work was begun too late last fall to give as satisfactory results as would have been obtained had it been commenced before the algæ had such a start. Algæ play an important part also in the matter of contamination of water supplies. Filtration, instead of benefiting, only aggravates the conditions, and the constant complaints of the public health officers and authorities in charge have made it necessary to make an earnest effort to prevent such contamination. Engineers and chemists have tried in vain to secure a remedy, and it now remains to be seen whether or not we may be able to solve the question. Encouraging results have already been obtained and have aroused much interest on the part of boards of health and similar organizations.

WORK OF PACIFIC COAST LABORATORY.

During the year the lines of work on the Pacific coast have considerably broadened, and, as heretofore, have been carried on, under the direction of the Pathologist and Physiologist, by Mr. Newton B. Pierce.

Plant breeding and selection.—The development of new forms by breeding and selection has been made a special feature of this work. Particular attention has been given to the improvement of the walnut, chestnut, and grape. The grape-crossing experiments, which have been conducted during several years, are nearing a stage of practical utility. Hundreds of seedlings, the results of crosses among raisin and table grapes, have recently been transplanted from nursery form in the San Joaquin Valley to open vineyard form in southern California. They are now under favorable vineyard conditions, so far as soil, water, and distance of setting are concerned, and many of them have already set fruit. It is hoped that this season's crop will be sufficient to demonstrate the value of the vines and that enough wood may be produced to warrant the distribution of cuttings within the next year.

Plant-introduction work.—During the year it has become more obvious than ever that Pacific coast conditions of climate, soil, irrigation, elevation, etc., are requisites which, if they could be drawn upon, would greatly add to the plant-introduction work of the Department. To facilitate such investigations a limited tract of desirable

agricultural land has, through private means, been secured in California, with satisfactory water rights, which will supply the more pressing present needs in a temporary manner. In addition to this a small tract of ground suitable for propagating, near the Pacific coast laboratory, has been secured in like manner, and this is accessible to a constant supply of city water, gas, sewerage, etc. Facilities in the way of temporary lath house, tool house, potting house, etc., are being placed on this property and will materially facilitate the various lines of work.

Pathological work.—The main lines of study during the year have been bacteriosis of walnuts, the vine diseases in the Santa Clara Valley, and the blight of loquats and pears. Many other plant diseases of minor commercial importance have also received attention.

MISSISSIPPI VALLEY LABORATORY AND INVESTIGATIONS.

The work carried on by the Mississippi Valley laboratory for the past year was divided into two distinct lines: First, the investigations concerning the decay of timber in live trees and in structural timber, together with methods used for preventing the same; second, investigations concerning diseases of fruit trees. In the first line of work cooperation was secured with the Bureau of Forestry. Dr. Hermann von Schrenk is in charge of this laboratory.

Investigations concerning the decay of timber.—This work has for its primary object the securing of knowledge which will aid in conserving the amount of timber on hand. By preventing the premature decay of wood it is possible to use not only the high-grade resistant kinds mainly employed at the present time, but also the inferior grades of wood which, under ordinary conditions, rot so rapidly as to be practically worthless. The knowledge which we have at the present time as to the best methods of treating wood so as to prevent decay is very fragmentary. During the past year special attention has been given to the investigation of methods of treating wood with a view to preventing its decay. This work as a whole involves not only extensive studies in regard to the causes of decay, but elaborate experiments in the impregnation of timber with different materials, with a view to determining cheap and effective methods of increasing its length of life. Special attention has been given to a serious disease of catalpa, a tree now largely planted in all parts of the Central and Western States; also to a trouble known as "blue" disease of pines. Nearly 600,000,000 feet of timber have been affected by this blue disease in the Black Hills. The blue wood has been considered unfit for lumber, mine timbers, or fuel, and as a result this immense quantity is being allowed to go to waste. Preliminary tests have already shown that the blue timber is practically as strong as the green wood and that its fuel value is scarcely less than that of the sound wood. Should these preliminary conclusions be borne out, it would mean the saving of many millions of dollars' worth of timber to the United States Government and also directly to the States which depend on the Black Hills as a source of timber supply.

Investigation of the diseases of fruit trees.—Experiments were conducted in a number of orchards in Missouri and Illinois for preventing the bitter-rot disease of apples. In addition, the life history of the bitter-rot fungus was studied, and the manner in which the fruits

become affected was determined. Extensive studies have also been inaugurated in the matter of the root rot of apple trees. Investigations of a disease known as crown gall were also begun, the object being to determine the method of infection of the crown-gall organism which attacks many fruit trees. This disease is becoming one of the most serious enemies to the fruit growers, and its ravages extend from California to the Alleghenies. It calls for very radical treatment, and it is believed that it can be successfully treated.

TROPICAL LABORATORY AND INVESTIGATIONS.

The tropical laboratory is located in Miami, Fla., and is in charge of Prof. P. H. Rolfs. The work conducted at this laboratory is of a miscellaneous character, and has for its principal objects a study of diseases of semitropical and tropical plants, the testing of plants adapted to semitropical conditions, and the care of such foreign plants and such hybrids as may have promise of value for southern portions of the United States. During the year work has been carried on on the root knot of the pineapple, the mango seedling blight, orange blight, and other diseases. Numerous plants from foreign countries have been received and planted, also seedling pineapple hybrids, and seedlings of the citrus hybrids obtained as a result of the plant-breeding laboratory's work.

WORK ON TOBACCO.

In October last Dr. R. H. True was detailed to the Bureau of Soils to continue the study of the fermentation and handling of tobacco begun by Dr. Oscar Loew. Dr. Joseph S. Chamberlain, an expert in physiological work, was also detailed to give assistance. Dr. True and Dr. Chamberlain spent some time in the fall and early winter at Tariffville, Conn., and Lancaster, Pa., in the study of fermentation processes as practiced in the making of wrapper leaf and filler leaf, respectively. Material was collected for further study in the laboratory. A thorough study of the constituents of the leaf at all stages of preparation was carried on in the hope that information might be gained which would shed light on the nature of the changes taking place in the tobacco and increase our information concerning the substances giving the desirable properties of the finished product.

In the early winter a communication was received from a prominent firm of eastern cigar manufacturers stating that the molding of cigars was a most troublesome problem and asking for information as to the cause and cure of the trouble. The matter was referred to Dr. True, who was able to demonstrate that the difficulty arose from the growth of certain organisms on the surface of cigars. Methods of dealing with the difficulty were worked out in the laboratory and have been given a factory test on a large scale. The results of these tests have shown that success has been achieved in controlling this trouble. The diseases of tobacco have been handled by Dr. McKenney, who has given considerable attention to a further study of the mosaic disease along the lines laid down by Mr. Woods in a recent bulletin on this subject. The oxidizing enzymes, which are to be considered the cause of the disease, have received special attention. Dr. McKenney has devised methods for the isolation of the oxidizing enzymes in a state of much greater purity than has previously been attained. Other investigations of tobacco diseases have been inaugurated, but as yet it is too early to report decisive results.

PLANS FOR CURRENT WORK.

The plans for the current year in the Pathological and Physiological Investigations have been referred to more or less from time to time under the items given as a record of the investigations for the fiscal year ended June 30, 1902. The work on sugar beets is being considerably enlarged, and a number of experiments are under way having for their object the determination of practical methods of holding in check some of the more common maladies. Owing to the resignation of Dr. B. M. Duggar, to which reference has already been made, some changes will be made in connection with the work on cotton diseases. A part of this work, particularly that under way in Texas, will be handled by Mr. C. L. Shear. Further field studies of the root rot disease in Texas will be carried on and experiments inaugurated to determine the best methods of prevention. In the work on wilt diseases of cotton further attention will be paid to the development of resistant types and the fixation of such types of resistant cottons and other crops used in rotation with cotton as have been under investigation. The investigation of cranberry diseases will be pushed as rapidly as the funds will permit, special attention being paid to a study of the life history of the fungi causing the diseases and experiments in the line of remedial measures. The diseases of orchard fruits will receive special attention, particularly the matter of practical treatment for the prevention of these troubles.

The investigations of "Little peach" have indicated pretty conclusively that the disease is transmissible by budding, and this would lead to the belief that radical measures must be adopted in controlling this malady. So far the investigations have shown that the disease is of such a nature that it can only be handled by such measures as have been adopted for peach yellows and rosette, viz, the systematic eradication of all trees showing infection. Plans have been made for putting into operation a systematic line of experiments of this sort, the object being to demonstrate the efficacy of such treatment and to convince those who may hesitate in regard to taking out such trees. The experiments in the treatment of bitter rot of the apple and of pear blight will be continued until satisfactory conclusions are obtained in regard to the best methods of treatment. In the plant-breeding work the investigations of cotton, corn, and other crops will be continued, with a view to securing crosses for special purposes. The work connected with the breeding of long-staple cottons will be continued. From the nature of this work several years will necessarily be required to obtain final results in many cases. It is particularly desirable that this work be extended to Arkansas, Louisiana, Oklahoma, and Texas. The promising hybrids already obtained should be tested and possibly further selected, to adapt special strains to this region. The work in the introduction and improvement of Egyptian cottons will be extended to other regions, and a careful study will be made of the markets for such cottons. In the case of corn, one of the most important lines of breeding investigation is the selection of more vigorous and productive strains of some of the ordinary standard sorts. This work will be continued in the District of Columbia, Virginia, Maryland, Michigan, Ohio, Indiana, and Tennessee. The work on the improvement of citrus fruits, pineapple, and other tropical or semitropical products, will be continued. In the pineapple especially it is desirable that there should be produced smooth-leaved, disease-resistant sorts of good quality, with large and attractive fruit. The only smooth-leaved

sort now grown is the smooth Cayenne, which is an excellent variety in almost every respect except that it is tender and subject to disease. The investigation of the alkali-resistant crops will be continued in cooperation with the Bureau of Soils, a special effort being made to obtain facts relative to the alkali resistance of different forms and to introduce new and promising forms from foreign countries. In the cereal work special attention will be given to encouraging the use of macaroni wheat by factories. Further studies will be made of the winter wheats with a view to extending their areas into regions where they have not been tested heretofore. The plans in connection with the work on nitrifying organisms in the Pacific coast and Mississippi Valley laboratories, etc., have been fully covered in the items given under work of the year, so that it is not necessary to repeat the statements here.

BOTANICAL INVESTIGATIONS AND EXPERIMENTS.

During the year the investigations of this branch of the Bureau have been pushed with the usual activity. The work of the Botanist, Mr. Frederick V. Coville, is largely administrative, but time has been found for continued investigations in geographic botany and aboriginal botany. The following is an outline of some of the more important lines of investigation:

SEED LABORATORY.

During the year there were tested in the seed laboratory 2,209 samples of seed, the larger part for both purity and vitality. There have been 1,544 accessions to the seed herbarium. Successful studies have been made on the germination of the more difficult grass seeds, such as Johnson grass, Bermuda grass, and Kentucky bluegrass. A comparative study of the seeds of rescue grass and chess, with drawings and descriptions, has been made. A comparative study of the seeds of Poa, which are of importance, has also been made. The field work of this branch of botanical investigations has been mainly in the line of that outlined last year. Studies on the harvesting, curing, and cleaning of Kentucky bluegrass seed has been continued. The field work was done in June of 1901, and the samples tested and results written up during the year 1901–2. Further observations on the harvesting of Kentucky bluegrass seed in Illinois, Missouri, and Iowa were made during June, 1902. Comparative experiments in red clovers of different origin were carried on by a number of experiment stations in cooperation with the laboratory. These experiments have shown that the European forms will not endure the hot sun as well and are not as early as our United States forms. The European forms have much more delicate stems than the United States forms and are almost entirely smooth, while the United States forms are very hairy. Observations of soil temperatures and continuous sowing of a variety of seeds have been carried on, the object being to determine the effect of alternating temperatures of the upper stratum of soil on the germination of seed. Soil temperatures were taken at eight different depths, varying from one-fourth inch to 2 feet, as well as the air temperature and solar radiation temperature. These observations were taken at intervals of fifteen minutes from one-half hour before sunrise until 10 p. m., from March 26 to July 1. Plantings of twenty varieties of vegetable and forage-plant seeds were made at intervals of two or three days during the entire period. The results of this work will show the

weather conditions under which different seeds germinate when sown in the open ground, and also under what artificial conditions the seed should be tested for germination. During the year a considerable part of the time of the force of the seed laboratory was devoted to the devising of plans for the rearrangement of the Congressional seed distribution. The testing of seed for this distribution also occupied a considerable portion of the time of the various assistants in the laboratory.

FIBER INVESTIGATIONS.

Fiber investigations have been carried on by Mr. L. H. Dewey, under the direction of the Botanist. During the year investigations have been conducted in regard to the hemp industry of the United States, the flax-fiber industry, the sisal industry in the Bahamas, and a preliminary list of the varieties of cotton manufactured in this country has been made up. Information has also been collected and recorded in available form in regard to numerous other fiber plants. Investigations of hemp have been made in Kentucky and Nebraska upon the methods of cultivating this crop and preparing the fiber. Seeds of six varieties of Japanese hemp have been imported and tested in the testing gardens of this Department and at the experiment station at Lexington, Ky., and also at Gridley, Cal., Fremont, Nebr., and Tottenville, N.Y. Two of these varieties promise to be of special value. Some preliminary investigations have been inaugurated on flax to obtain information on the methods of flax-fiber production in eastern Michigan. The average annual importations of flax fiber amount to about $1,500,000, and it is believed that much of this fiber can be profitably produced in this country. There will be need, however, of some improvement in the present rather crude and expensive methods of harvesting, retting, and thrashing the flax, and preparing the fiber. There is also opportunity for improvement by the introduction of better varieties and the development of a better grade of fiber by careful selection of seed. During the past year the price of sisal fiber has been higher than at any other time for fifteen years. The supply has not been equal to the demand, and owing to the increased use of binder twine in harvesting our grain crops, and especially in harvesting corn, the consumption seems likely to increase. An investigation in regard to the methods of cultivating the sisal plant and preparing the fiber in the Bahama Islands has been made, with a view to securing information that may aid in the introduction of this industry into Porto Rico and also aid the industry which is becoming established in Hawaii.

TROPICAL AGRICULTURE.

This work is in charge of Mr. O. F. Cook, and during the year the subjects which have received special attention are coffee culture and the culture of the Central American rubber tree. The coffee-growing regions of Porto Rico were visited in July, 1901, and those of Guatemala and southern Mexico in March, April, and May, 1902. The results of these investigations are being embodied in three reports, the first showing that the coffee industry is limited in extent and productiveness by bad cultural methods, such as the use of too much shade and the failure to raise seedlings in nurseries; the second showing that coffee of the highest grade produced in America is grown without shade, and that shade is being abandoned or the amount

greatly reduced in the best-managed plantations, and the third showing that none of the coffee varieties is equal to the parent type in productiveness, with reasons for believing that this deficiency is due to close breeding. The culture of the Central American rubber tree (Castilloa) has received special attention, and some interesting data have been secured which will be used in developing this industry in the future.

DRUG AND MEDICINAL PLANT INVESTIGATIONS.

Under the direction of the Botanist, Dr. Rodney H. True has conducted work on drug and medicinal plants. The work was not organized until late; consequently there is little to report in the way of results. There is an increasing interest in this work owing to the fact that a considerable portion of the plants now used as drugs are imported. The amount of money annually sent abroad for plants of this kind will probably aggregate $8,000,000, and there is no reason why a considerable portion of this should not be secured to our own people by the growing of such plants in this country. With a view to encouraging this work, cooperative experiments on the culture of belladonna, digitalis, stramonium, hyoscyamus, aconite, arnica, licorice, and the opium poppy have been arranged and inaugurated with a number of experiment stations, as already set forth in the early part of this report. Small plats of drug plants are being grown in the hope of learning the influence of climate, latitude, etc., on the development of the plants in question, and on the production of their characteristic active principles. A similar experiment is being carried on at Madison, Wis., by Mr. Albert Ovenden. At Dover, Mass., Mr. George H. Woodhull has planted one-half acre of drug-producing plants, for the purpose of giving the culture of these plants for the market a practical test. At Washington, experiments on a small scale have been undertaken at the Arlington Farm and on the Potomac Flats. On the Arlington Farm, plats aggregating one-half acre have been seeded with the kinds of plants already enumerated, and a like area on the Potomac Flats has been similarly treated. Small separate cultures of aconite, valerian, golden seal, and Seneca snakeroot, under special conditions, are also located here.

POISONOUS PLANT INVESTIGATIONS.

This work, conducted by Dr. V. K. Chesnut, was carried on almost exclusively in the office; but the month of July, 1901, was devoted to laboratory and field investigations in Montana, and from July to February special laboratory studies were made at Bozeman, Mont., and the Johns Hopkins Medical School. The laboratory work resulted in the discovery, first, that the effect of at least two of the loco weeds of Montana is unquestionably due to some chemical compound which they contain; second, that the poisonous principle of *Zygadenus venenosus* is an alkaloid closely related to veratrine, the physiological effect of which can be offset by the use of diuretics. During the fiscal year ended June 30, 1902, 35 cases of plant poisoning were investigated. These do not include cases investigated in the field, and the number unquestionably falls very far short of the number of cases which actually occurred during that time.

GRAIN INSPECTION AND NOMENCLATURE.

The grain-inspection work of this office is in charge of Mr. C. S. Scofield, and has for its object (1) the study of methods and characters used in the determination of different varieties of wheat and (2) the study of commercial grades of cereals. The investigations on varieties, especially the factors influencing deterioration in transit and storage, have had to do chiefly with arranging for experiments at a number of experiment stations for work on classification of wheats in which these stations are particularly interested.

The work on commercial grades consisted in gathering data on methods now in vogue of sampling and grading grain and in collecting samples of carloads and cargoes for accurate mechanical analysis and moisture determinations. The results of these analyses will probably furnish a more accurate basis for commercial grades than the printed rules now used by inspectors in various markets.

TESTING GARDENS.

The testing gardens have been carried on, under the direction of the Botanist, by Mr. W. R. Beattie. The principal work has been along the lines of general trials or variety comparison work. Aside from the testing of Congressional seeds, a large number of samples of lettuce, radishes, beets, cucumbers, melons, etc., have been planted and compared. About 360 samples of foreign melons and cucumbers were noted and compared, and hand-pollinated seeds of the promising sorts saved in many cases. These seeds have been sown this season for further comparison with native varieties. Several varieties of soy beans and cowpeas lately imported from Japan and Korea were planted last year with a view to determining earliness in maturing; also to secure a larger amount of seed. The seed thus obtained has been resown this season for the purpose of further study of the varieties and the production of a quantity of seed sufficient for trial on a larger scale by experimenters. During the year special attention was given to the celery industry, including cultural methods, variety comparisons, and the preparation of a bulletin giving simple directions how to grow the crop. The cultivated varieties of okra have all been grown and compared, and in most cases their synonomy determined.

CURRENT WORK.

The increased work in the seed laboratory has made it necessary to secure additional quarters, and to accomplish this, arrangements have been made for a new laboratory building which will greatly facilitate the work. The pure seed investigations of this laboratory will be continued, and, in addition, special efforts will be put forth in the matter of encouraging the production of certain kinds of seed in this country. The fiber investigations will be extended to include some special studies of flax, hemp, and other plants, in line with the suggestions already made under the notes given on the work of the year. Owing to the importance of the drug and medicinal plant investigations, a special effort will be put forth to enlarge the scope of this work, and experiments will be inaugurated to determine the practicability of growing promising drug and medicinal plants in various parts of the country. It is to be regretted that the funds now at command will not permit of very extended work in this direction, as it is believed

that the investigations are of great importance. In the cereal investigations the work will be continued practically on the same lines as last year. The investigations regarding wheat varieties will consist in straightening out, as much as possible, the confusion now existing in names of varieties of wheat by photographing standard variety types and giving list of synonyms, together with descriptions of all types described. If possible, Pacific coast wheats will be studied and a collection of these types added to the one already named. The work on commercial grades of grain will be a continuation of the collection and analysis of the samples of grades, together with a further study of methods of work in vogue at the various export ports and larger grain centers. It is hoped that the results of this portion of the work may be prepared for publication before the close of the present fiscal year, and that this publication may include not only a proposed accurate basis for commercially grading corn, but may also give an idea of the varied types and comparative qualities of our cereal grades, together with the results of studies as to causes of the deterioration of corn in transit and storage.

GRASS AND FORAGE PLANT INVESTIGATIONS.

There is widespread interest in the work on grass and forage plants, and during the year investigations in this field have been considerably broadened. Prof. W. J. Spillman, the Agrostologist, reports on the following lines of work under his charge:

RANGE IMPROVEMENT.

Studies relating to range improvement have been continued during the past year with the cooperation of stockmen and others interested in range problems. This work has, for the most part, been in charge of Mr. David Griffiths, who has explored range areas in a number of western States and Territories. The principal objects aimed at in these explorations are to ascertain what methods of range management are conducive to best results, to study the effects of various classes of stock on range conditions, to study the native vegetation with a view to protecting and propagating that which is valuable, and to study the relation of denudation to surface washing, with a view to preventing such washing. More than 1,000,000 square miles of the public domain, because of deficient rainfall, are suitable only for grazing. This area formerly supported great herds of wild animals, and later of horses, cattle, and sheep. As long as the ranges furnished both summer and winter subsistence, the native forage plants flourished. The amount of stock the ranges could support being limited by the supply of winter forage, the summer growth was sufficient to produce abundant seed. But with the introduction of hay farming in such localities as were suitable, and the use of this hay for winter food for stock, the amount of stock increased till, in many parts of the range area, the summer growth of grass and other forage was completely consumed. Lack of opportunity to produce seed, together with the excessive trampling of increased herds, has led to rapid deterioration of the ranges. Investigations are now in progress with a view to ascertaining the amount of stock various sections of the range country can support without injury to the native vegetation. Arrangements are nearly completed for fencing an area large enough to be handled as an actual range. The amount of money

heretofore available for such work has been entirely inadequate; in view of the fact that for several years' past there has been an increasing deficiency in live-stock products, it is believed that larger appropriations should be made for this work.

SUBSTITUTE FOR RED CLOVER.

Reports received by this office during the year indicate that for five or six years past there has been increasing difficulty in securing a crop of clover in sections where clover has long been the leading leguminous crop. This is particularly the case on upland gravelly soils in the Middle Northern States. The causes of this difficulty and the remedy for it are unknown. Under such circumstances it is natural that attention should be turned to other legumes to take the place of clover. During the year this office has paid particular attention to alfalfa, cowpeas, and soy beans, the work being in the special charge of Mr. A. S. Hitchcock.

Alfalfa.—A study has been made of varieties of this crop secured in different countries, and some varieties have been found that are of special interest to farmers in the clover-producing section. A variety from Peru has been found to make a larger growth, to stand up better, and to resist disease better than the common alfalfa of the Western States. A portion of an importation from Asia has been found to resist the severe winters of the northern prairie States. During the year more than 4,000 pounds of alfalfa seed have been used in cooperative experiments between this office and experiment stations and farmers in the Middle and Eastern States. It has been shown that alfalfa is a valuable hay crop in all parts of the humid region on certain types of soil. The best methods of starting this crop have been determined, and it is now comparatively easy to secure a good stand in parts of the country where alfalfa had previously been tried without success. Mr. C. R. Ball has had charge of the testing of varieties, and Mr. A. S. Hitchcock of the cooperative work with farmers.

Cowpeas.—Since alfalfa is better adapted to permanent meadows than to rotation cropping, there is a need for leguminous crops to grow in rotation with grain crops. Of those tried for this purpose none gives more promise than cowpeas. Very little is known of this crop in the clover section, and this office has undertaken to collect and grow all available varieties in order to be able to meet the pressing demand for information concerning them. Some seventy-five varieties are now being grown at Arlington Farm under the close scrutiny of Mr. C. R. Ball and Mr. W. M. Pollock, and a careful record of all important characteristics of each variety is being made. Seed of several varieties has been distributed in the Middle and Eastern States, where they are most needed, and most encouraging results have been secured.

In addition to the study of cowpeas as a substitute for clover, this office is studying varieties adapted to rotation farming in the South, where the crop is already an important one. It is intended during the coming year to make selections of individual plants with a view to improving standard varieties for hay-making purposes. The common faults to be overcome are coarseness of vine and the ease with which the leaves are broken off in handling.

Soy beans.—During the year seeds of soy beans have been distributed in the clover section, and much valuable information about this

crop has been collected. It is particularly valuable because of its frost and drought-resistant qualities and its upright habit of growth. Its one objectionable feature is the coarseness of its stems. Studies are in progress in order to secure varieties with stems less coarse and woody. It is well known that the rate of seeding materially affects coarseness of stem, and studies will be made the coming year to ascertain the proper amount of seed to sow per acre. This work is under the charge of Mr. Ball and Mr. Pollock.

FORAGE PROBLEMS IN THE SOUTH.

The continued cultivation of cotton in the Southern States, with constant reliance on expensive commercial fertilizers, has resulted in such depletion of humus in the soil that, in many places, cotton culture is no longer profitable. This office has given much attention during the past year to forage plants for the South. Typical localities were selected in which quantities of alfalfa, cowpeas, soy beans, beggar weed, rescue and Italian rye grass were sown in cooperation with farmers. All of these crops have been reported on favorably, and we shall attempt to extend their cultivation as a means of preparing the way for more extended live-stock farming in the South. A study of native forage plants and grasses is also being made with a view to increasing the hay and pasture resources of the South. Mr. P. L. Ricker, of this office, is now in the field collecting the seed of valuable native grasses in that section. These will be tested the coming year for meadow and pasture purposes.

JOHNSON GRASS.

Experiments on the extermination of Johnson grass in the Southern States have been continued by Mr. Ball, and it has been shown that prolonged clean cultivation will eradicate this pest. A bulletin has been issued giving the results of these experiments. Arrangements are nearly completed for a series of experiments in several States the coming year in order to ascertain whether Johnson grass, and the still more formidable pest, nut grass, can be eradicated by continued growing of a winter grain crop followed by a summer shading crop, such as velvet bean or cowpea.

SUBSTITUTES FOR KENTUCKY BLUEGRASS.

Information received in this office during the past two years indicates that on the rich, black prairie soils of the Central and Northern States, especially when properly fertilized with barnyard manure, Kentucky bluegrass is perhaps the best possible pasture grass. But on upland soils that are inclined to be gravelly, bluegrass does not yield as much pasture as some combinations of other grasses. This is partly due to the abundance of weedy and bushy growths on these soils, and experiments are being undertaken to determine the effect of keeping down such foreign growth. The effect of the application of fertilizers to pastures is also under experiment, and it is hoped that valuable results will be obtained. In those sections where bluegrass is not at its best experiments have been started with combinations of other grasses and clovers known to be valuable for pasture. These will be pushed with vigor during the coming year.

GRASSES WITH PARTIAL IRRIGATION.

In all the irrigated sections of the arid region there are considerable bodies of land which can be given irrigation in early spring while water is abundant, but which can not be irrigated in midsummer for lack of water. Questions frequently come to this office about various grasses for such situations. Cooperative experiments were begun the present year, under the direction of Mr. Hitchcock, to test the value of alfalfa and brome grass with different amounts of irrigation water. These investigations will be extended to other grasses, and will be duplicated in several western States.

SOIL AND SAND BINDERS.

A bulletin has been issued during the year giving results of investigations with sand-binding grasses in California (Bureau of Plant Industry, Bulletin No. 12), and another is now in course of preparation. Experiments have been started in Michigan, on the sand dunes along the east shore of Lake Michigan, and an assistant is now in the field studying conditions on the North Atlantic coast, with instructions to institute a series of experiments in that region.

A number of grasses have been found that can be grown successfully on sand dunes, and plantations of these have been made. Investigations begun on the Oregon coast several years ago are still in progress and a considerable area of sand dune has been reclaimed.

During the coming year experiments will be conducted with soil-binding plants on railroad and other embankments in the interior. Mr. Hitchcock has charge of this work also.

ROTATION OF CROPS.

A study is being made of crop rotations in various parts of the country, and cooperative experiments on this subject have been undertaken with other offices of this Bureau and several of the State experiment stations. Considerable time is required to secure results in investigations of this character. It is therefore important that these experiments be extended in the immediate future to as many parts of the country as possible in order that valuable time may not be lost. Increased appropriations for this purpose are earnestly recommended.

OVERFLOWED LANDS.

In every State and Territory there are considerable bodies of land subject to annual overflow. These lands are generally exceedingly rich, but on account of the overflow, which usually comes in the spring or early summer, they are not available for the cultivation of ordinary crops. Investigations have been inaugurated in order to secure meadow and pasture grasses that will thrive on such lands. In many places much hay is made on swampy soil, and the native vegetation on such soils is being studied. Several agents are now in the field collecting seed, and plantings are arranged for in one locality in the State of Illinois. This work will be extended as fast as funds will permit.

METHODS OF HAY MAKING.

It is well known that the value of hay depends largely on methods used in handling the grass after it is cut, as well as upon the particular stage at which it is cut. The hay crop is the most important crop in this country, and millions of dollars are lost annually by American farmers by improper methods of hay making. It is highly desirable that this office should undertake the study of this most important subject. The limited force in the office has made it impossible to do this up to the present time, but a start has been made in the study of this question. This work will be extended as fast as funds will permit.

FEEDING TESTS WITH FORAGE CROPS.

During the past decade many new and valuable grasses and forage crops have been established in this country, and there is a pressing demand for information concerning their feeding value. Experiments of this nature call for the highest skill and considerable outlay of money. Hence few such experiments have been conducted. It is important that this work should be undertaken at once, and arrangements for it in cooperation with other Offices and Bureaus of the Department and some of the State experiment stations have already been completed.

GRASS GARDENS.

Studies on grasses and legumes have been continued in the grass garden on the Department grounds by Mr. Ball and Mr. Pollock, and a careful record has been made of those characteristics of each which bear an economic value. A set of labels has been prepared showing the common and the botanical name of each species for the benefit of those who may be interested. This collection of plants is visited annually by many people and much valuable information is thus disseminated. Several varieties of alfalfa have attracted particular attention during the present season, and the vigorous growth of this crop in the grass garden has been the means of encouraging its cultivation in many parts of the country. The particular value of this garden lies in the fact that its location makes it easily available to the many visitors to the National Capital from all parts of the country. One of the most interesting features is the miniature sand dune on which several of the leading sand binders are grown.

During the past year the office maintained an extensive grass garden on the grounds of the exposition at Charleston, S. C. All the leading southern forage crops were grown, and many others from various parts of the world. The correspondence that has come from southern farmers and notices in southern newspapers indicate that this garden was one of the most instructive features of the exposition. There have been numerous calls for information concerning the most successful crops in the garden, and it is believed that the exhibit will have an important influence on southern agriculture.

ARLINGTON FARM.

Collections of varieties of leading forage crops have been started at Arlington Farm, and these are being carefully studied. Cowpeas have proven especially valuable on this soil, and much attention will be

given them during the coming year. During the present season, certain dealers have advertised extensively a supposed new forage plant, and large quantities of seed have been sold at exorbitant prices, under the name "Penicillaria." This plant has been grown in comparison with the well-known pearl millet, and proven to be identical with it. A circular will be issued soon giving the results of this test, in order that farmers may be protected against a similar imposition next season.

As soon as the land is available, permanent experiments will be inaugurated with a view to investigating all the leading problems relating to grasses and forage plants in this country.

SEED DISTRIBUTION.

This has been carried on in connection with our cooperative work with the agricultural experiment stations and also with private experimenters.

Seeds of 130 different forage plants were distributed, a total of over 5,500 packages being sent to more than 3,000 experimenters. This distribution comprises over 1½ tons of alfalfa seed sent to all parts of the country, but more especially to the Northern and Eastern States outside of the recognized alfalfa region; large quantities of cowpeas and soy beans sent to the whole eastern half of the country; many annual forage crops and Bermuda grass sent to the Southern States or distributed to applicants at several farmers' institutes by members of the office force; seed of Kafir corn, awnless brome grass, and other drought-resistant forage plants sent to the Great Plains or the semi-arid regions of the West. In addition, smaller quantities of the seeds of sand binders and alkali-resistant grasses and other plants were distributed. The system of records of the seed distribution and reports on results secured is still essentially the same as that described in Bulletin No. 10 of the Bureau of Plant Industry, though the form of the report has been modified somewhat.

COLLECTION AND DISTRIBUTION OF SEEDS OF NATIVE PLANTS.

Several agents are now in the field collecting seeds of valuable native grasses, particularly those adapted to arid regions, sandy land, and overflowed lands. These will be used either in our own investigations, or distributed in those sections where they will be of most value. It is the policy of the office to collect considerable quantities of a few of the more valuable species, rather than small quantities of a large number of less valuable ones. It is believed that more valuable results will be obtained in this way, as it enables us to test more thoroughly the value of the seeds collected.

LAWNS AND LAWN MAKING.

Investigations with lawn grasses have been continued during the year. These have shown that Korean lawn grass is superior for lawn purposes to Bermuda grass in the vicinity of Washington and in the Southern States. It makes a denser growth and starts much earlier in the spring. It is particularly valuable in the Southern States, and an effort will be made next season to introduce it generally in that section.

HERBARIUM.

A complete collection of species of grasses and forage plants is indispensable to the work of this office. Specimens are received almost daily for identification, and these specimens are frequently in such condition that they can be identified only by comparison with herbarium material. The time of one assistant has been very fully occupied with this work during the past year. The present quarters in which the herbarium is kept are wholly inadequate for the purpose, and it is hoped that more room can be made available for the collection during the coming year.

CURRENT WORK.

During the current year work is in progress as follows:

Seeds of several valuable native grasses are being collected, part of which will be used in our own investigations and part distributed to the State experiment stations and to selected experimenters in various places. These seeds belong to the following classes:

Soil and sand binders.

Grasses for overflowed lands.

Hay and pasture plants for arid, semiarid, and alkaline soils.

Hay and pasture grasses for the Southern States.

Alfalfa.—We are growing several new varieties for study of habits and characters. We are working in cooperation with experiment stations and many farmers, attempting to introduce alfalfa into the Eastern States. Reports already received show undoubted success in this work.

Sand and soil binding.—We are making experimental plantations at Astoria, Oregon, at several places in Illinois and adjacent States, and on Cape Henry, Maryland. We are exploring and mapping the areas of drifting sand in the Columbia River basin, in Michigan, and at several points on the Atlantic coast. Several sand binders are being tested on an artificial sand dune on the Department grounds. Mr. A. S. Hitchcock is now in Europe studying sand-binding work done there during the past one hundred and fifty years.

Overflowed lands.—We are studying the natural herbage that is cut for hay on overflowed and swamp lands—Mr. Hitchcock in Wisconsin, Mr. Griffiths in Oregon, Mr. Ricker in Maine, and Mr. E. N. Wilcox in Illinois. We have made an extensive plantation of grasses on overflowed land near Pekin, Ill., Mr. Wilcox being in charge.

Mr. C. R. Ball will continue the work at Arlington Farm, where we are carrying on variety tests of cowpeas, soy beans, the nonsaccharine sorghums, and pearl millets. Last spring we secured all the available varieties of these plants, and we are studying them with a view to ascertaining their adaptability to various farm conditions. We are making comparative tests of millets, cowpeas, velvet beans, soy beans, vetches, wheat, macaroni wheat, emmer, oats, rye, and barley as forage crops. We are testing the millets, teosinte, and the saccharine sorghums for their yield of green forage. In this work at Arlington Farm Mr. Ball is assisted by Mr. W. M. Pollock. This is also the case in the work of the grass garden located on the Department grounds. In this we are growing various varieties of clovers, alfalfas, beans, peas, hay and pasture grasses, lawn grasses, sand-

binding grasses, and a number of novelties, such as Mexican clover, the madder plant, and so on. These are grown principally for the instruction of visitors.

Mr. David Griffiths is engaged in the study of problems of range management on our western ranges. He is now exploring the ranges of Oregon and Washington and will proceed thence to the Territory of Arizona, where we have arranged for some extensive and carefully conducted experiments on this problem. We are preparing to fence 100 square miles of range land that is badly denuded, in order to protect it from stock and to control the ranging of stock upon it when we are ready to admit them. This work is done in cooperation with the Arizona experiment station. We are also cooperating with the experiment stations in Kansas, South Dakota, and Washington on work of a similar character.

In our cooperative work with the experiment stations we are working on soil and sand-binding plants with the States of California, Michigan, and Oregon; cover crops for orchards in Delaware; grasses and forage plants for arid lands in Kansas, South Dakota, and Wyoming; the rotation of crops, with Kentucky and Tennessee; testing miscellaneous forage plants, Kentucky and Tennessee; soiling and silage crops, Kentucky, Maryland, and Tennessee; the establishment and maintenance of meadows and pastures, Kentucky, Missouri, Nebraska, North Carolina, and Tennessee; the value of farm crops as feed for beef cattle, with Missouri; testing newly introduced forage plants, Nebraska and North Carolina; testing annual hay crops, Nebraska and Tennessee; experiments with fertilizers, Tennessee; experiments on haymaking, Tennessee; grasses and forage plants with partial irrigation in the arid regions, Utah; grasses for wet and overflowed lands, Vermont; grasses and forage plants for alkali soils, Wyoming.

We are conducting experiments in cooperation with farmers in Texas on the best methods of exterminating Johnson grass. This work is under the immediate charge of the Agrostologist. We are investigating the cropping systems in vogue in various parts of the country and studying the relation between the cultivation of forage plants and their utilization upon the farm as stock feed and the maintenance of soil fertility. We are attempting to produce a new legume that shall grow erect like the soy bean, hold its leaves well in haymaking, produce an abundance of seed valuable for feed and easily harvested, and have a stalk which can be made into palatable hay. We hope to do this by crossing available varieties of either cowpeas or soy beans. We are planning to do both.

Mr. P. L. Ricker has taken general charge of the herbarium and attends to the determination of miscellaneous grasses as they are sent in.

The clerical force of the office, in addition to attending to the correspondence of the office, will collect and index information on grasses and forage plants, and will map the distribution of a number of the more important ones.

POMOLOGICAL INVESTIGATIONS.

To accommodate the rapidly increasing work of this office the various lines of activity in pomological investigation were divided at the beginning of the fiscal year into two somewhat distinct groups under the general direction of the Pomologist, Col. G. B. Brackett. The first of these groups includes the very heavy routine work of

correspondence, administration, and laboratory, including the examination, identification, description, illustration, and modeling of fruits for record, as well as the preparation of the varietal index of fruit varieties. The second group, which is designated under the subhead "Pomological field investigations," includes the subjects of fruit marketing and storage, viticultural investigations, and fruit district investigations. The work of the first group is directed by the Pomologist in person; that of the second by the Pomologist in charge of field investigations, Mr. William A. Taylor. The following outline of the work of this office has been submitted by the Pomologist:

ROUTINE WORK.

The general routine work of this office has been heavier than in any previous year, and has yielded important and interesting results. The personal correspondence with individuals in relation to pomological topics shows a material increase, notwithstanding the fact that a large proportion of ordinary correspondence is accomplished through the agency of circulars. More than 13,000 letters have been written during the year. The receipts of specimens were considerably heavier than in any previous year, and represented 48 different States, Territories, and dependencies, as well as 12 foreign countries. A large proportion of the fruits received was sent by the growers for identification, and of these it is gratifying to state that fully 75 per cent were satisfactorily named for the senders.

In cooperation with the office of Seed and Plant Introduction, seeds, scions, or vines of a large number of fruit varieties from foreign countries have been distributed to private experimenters and experiment stations in different parts of the country. The more important fruits distributed through the agency of this office have been as follows: Apple, 350 varieties; grape, 75 varieties; pecan, 19 varieties. A cooperative test of the relative adaptability of Mazzard and Mahaleb stocks for the cherry in the South has been started, the plantings being located in Virginia, West Virginia, and Tennessee. In a few instances material of this sort has been purchased for distribution, though by far the larger portion of the material distributed has been donated by generous originators or fruit growers who desire to have their promising varieties tested in other sections than their own. In cooperation with the Horticulturist of the Bureau, about 400 varieties of the apple have been root grafted as a nucleus for an orchard of standard varieties on the newly acquired Arlington Farm. Work along this line will be continued and increased during the coming year.

In the regular routine work of the office more than 700 fruits have been described, nearly 400 have been painted, somewhat over 300 models have been added to the collection, and about 1,300 herbarium specimens have been added to the varietal herbarium during the year.

The work has been continued on the varietal index, with special reference to completing the catalogue of the apple at the earliest possible date. This is regarded as our most important economic fruit, and the one in which the greatest confusion as to names exists among growers. An additional feature of this index is being developed in the way of an historical index, in which are recorded as many of the authentic historical facts relating to fruit varieties as can be located in literature or through correspondence. The usefulness of this feature has already been frequently demonstrated in the current work of the office.

POMOLOGICAL FIELD INVESTIGATIONS.

FRUIT AND VEGETABLE MARKETING.

Under this head a series of investigations and experiments has been conducted looking toward the development of export trade in American fruits and vegetables, and the improvement of methods of handling and storing these products, both for domestic and foreign use.

Through experimental shipments made in cooperation with fruit growers in New York, Virginia, and West Virginia, certain important facts have been pointed out that are likely to have influence upon the development of export trade.

Thus, through an experimental shipment of Bartlett pears made from Niagara County, N. Y., to London, in September, 1901, in cooperation with seven members of the New York State Fruit Growers' Association residing there, it was demonstrated that with proper care in picking, packing, and forwarding, this variety can be laid down in good condition in the London market. With this, as with other early and perishable fruits, ocean refrigeration is essential, and for localities as distant from the seaboard as the one in question, refrigerator-car service to the steamer side is important. In the experiment referred to, an effort was made to determine what style of package is best adapted to the export shipment of this variety of pear, whether wrapping of the fruit is either necessary or desirable, and whether the demand for fruit of this character at the season when the fruit must be marketed is likely to be sufficient to warrant commercial shipments. To test these points, a quantity equal to about 50 barrels of Bartlett pears, grown by the seven gentlemen referred to, was carefully graded and packed in a single packing house, under the supervision of a representative of the Department, to insure uniformity in grading and quality. This fruit was packed in three styles of package, the ordinary barrel commonly used in that section, a 40-pound box, and a 20-pound half box. Part of the fruit in each kind of package was wrapped with waxed paper, the remainder being forwarded without wrapping, in the ordinary way. The shipment was forwarded to New York in a refrigerator car and was transferred at that point to a refrigerated compartment on the steamer *Minnehaha*, with instructions to hold the temperature at 36°. It was consigned to a prominent fruit house in London, with instructions to make careful examination of the several lots, and report on their relative condition; then, to sell each upon its merits. The fruit was reported in excellent condition on arrival and was sold at prices that yielded the following net returns at the packing house in western New York for the "standard" grade after all transportation and sales charges were paid:

Package.	Net returns.		Gain due to wrapping.
	Unwrapped.	Wrapped.	
Barrel	$4.22	$4.91	$0.69
40-pound box	.83	1.52	.69
20-pound, one-half box	.38½	.72	.33½

The experiment was not decisive as to the relative merit of the three kinds of package for this fruit, but the receivers favor the box

and half box in comparison with the barrel. The necessity for wrapping was strongly brought out, however, as the actual net gain due to wrapping, ascertained by deducting the cost of paper and labor, as nearly as could be determined, amounted to 2 per cent with barrels, 62 per cent with boxes, and 63 per cent with half boxes on fruit of exactly the same quality. The prices realized for the wrapped fruit were very satisfactory, indicating that with proper ocean service the exportation of Bartlett pears in seasons when that variety is in surplus will be worthy of the attention of growers and shippers.

In sharp contrast with the marked beneficial results of wrapping Bartletts were the negative results on Kieffer pears obtained in a test shipment of that fruit made from Winchester, Va. Ten barrels of this fruit were forwarded by ordinary freight to New York early in October, and thence in common stowage to London, via Southampton. Part of the fruit in this shipment was wrapped with white print paper, part with parchment paper, and the remainder went unwrapped. The account sales showed no difference in price, indicating that with this pear, for immediate sale, at least, wrapping is unnecessary. The price realized on this shipment—$5.84 per barrel in London, netting $3.57 per barrel at Winchester, Va.—was very satisfactory. The outlook for profitable exportation of well-grown and well-colored fruit of this widely planted commercial pear appears good.

A small shipment of Bilyeu peaches was made in October from West Virginia, with a view to testing the demand for late fruit in London. It was packed in 6-basket carriers, each peach being wrapped, and was forwarded by express to New York without ice. Through the courtesy of the steamship officials space was secured for the shipment in the steward's refrigerator on the steamer *St. Louis* from New York, October 16. The shipment reached London October 25, and was sold at auction on the same day. The fruit was reported to show some discoloration on arrival, but sold at an average price of $5.48 per carrier containing about 3 pecks, netting at the shipping point about $4.50 per bushel after all expenses were paid. As late peaches of good size, color, and shipping quality are largely grown in the Allegheny and Blue Ridge peach districts, the opportunity for a profitable outlet for their product in this direction is encouraging.

In vegetables the experimental export work was confined to the sweet potato. In cooperation with the Bureau of Animal Industry a series of semimonthly shipments of this vegetable were made from Virginia and New Jersey during the autumn and early winter. One lot of 100 barrels was shipped and stored in London to determine the storage durability after shipment. It was demonstrated that from points conveniently situated as regards railroad transportation to the seaboard this vegetable can be safely shipped direct from the field in ventilated barrels and forwarded in common stowage. Later in the season wrapping with paper appears to prolong the durability, and therefore to lessen the risk. Though this is comparatively an unknown vegetable in British markets, London dealers are of the opinion that a gradually increasing trade can be developed there. At the present time prices are high and the consumption is therefore necessarily restricted. Leaflets on the uses of sweet potatoes in cooking are distributed with the product, and the effort to familiarize consumers with its merits is believed to be worthy of continuation.

FRUIT STORAGE.

The work on fruit storage, which has been in charge of Mr. G. Harold Powell, assistant pomologist, was mainly limited to pears and winter apples. The problems to which particular attention was directed were the cold-storage requirements of the Kieffer pear and the control of "scald" in a number of commercial varieties of winter apples.

With the Kieffer pear an effort was made to determine by comparative tests the proper stage of ripeness for picking, the method of handling necessary, the most suitable temperature for storage, and the relative durability of wrapped and unwrapped fruit under different conditions. While the results of a single season can not be taken as final, it has been demonstrated that a delay of ten days in storing after the fruit is picked and packed is sufficient to account for its rapid deterioration in storage within thirty days thereafter at any practicable temperature, while fruit from the same trees stored immediately after picking in the same temperature was held in perfectly sound condition for a period of five months. There have been numerous heavy losses by growers and dealers in this and former years, which in the light of these investigations were easily preventable through proper handling of the fruit.

Through carefully conducted duplicate storage experiments, made with commercial varieties of apples at Washington, D. C., Buffalo, N. Y., Champaign, Ill., and Kansas City, Mo., using fruit from Virginia, New York, Illinois, Missouri, Kansas, and Arkansas, certain important facts have been discovered in regard to methods of controlling or retarding the "scald" which frequently does serious injury to commercial apples otherwise valuable. It has been found that by delaying the picking and packing of the fruit until it is well colored and ripened, and storing at a temperature of 32° to 33° in the storage houses, the development of the "scald" can be retarded for several weeks or months longer than by the early picking generally recommended. During this time the fruit thus handled is in perfect condition for sale and consumption. In the case of some such important commercial varieties, as Rhode Island, Winesap, and York Imperial, the percentage of "scald" was reduced from 25 to 90 per cent by certain methods of picking and storing which did not involve any material increase in the cost of handling the fruit either in the orchard or storage house. Work along this line will be repeated and will be extended to other commercial regions and varieties as rapidly as the funds available permit, as it is considered of immediate and practical value to orchardists. A clear understanding of the principles involved is likely to largely increase the net proceeds of the winter apple crop, and at the same time to afford the consumer a more wholesome product.

Comprehensive varietal tests to determine the relative storage value of the newer varieties of apples have also been conducted both with fruit obtained from individual growers and with that furnished by the experiment stations of Maine, New York, Virginia, and Kansas, which have actively cooperated with the Department in the work.

VITICULTURAL INVESTIGATIONS.

The viticultural investigations which were begun in 1899 have now reached a stage where they are developing rapidly, and promise to be of distinct benefit to a large section of the country. Mr. George C. Husmann, expert in viticulture, is in charge of these.

During the year several lines of viticultural investigation have been inaugurated in addition to those previously begun. A comprehensive descriptive index of varieties of Vinifera grapes, with their full synonyms, has been commenced and will be added to as rapidly as the other duties of the expert permit. A beginning has been made in forming a viticultural herbarium, and nearly 200 varieties of grapes have been received and described.

An experiment was made early in 1901 to determine the effect of the hot-water dip sometimes used to rid grape cuttings of Phylloxera infestation. In this experiment grape cuttings were treated by dipping in water at different temperatures from 122° F. to 140° F. for varying lengths of time. It was found that no injury resulted from a temperature of 122° F. for five minutes. At the same temperature a dip of ten minutes resulted in decided injury, while at 140° F. for five minutes the cuttings were practically all killed. The effect of the dip was accurately determined by planting equal numbers of cuttings, both in the open ground and in the greenhouse and making observations upon them as the season progressed.

An extensive experiment in bench and field grafting of Vinifera grapes of different types and varieties on different resistant stocks has been begun. This experiment is made with a view to determining as promptly as possible the relative congeniality of different Vinifera varieties to different resistant stocks, as well as the relative rooting characteristics and adaptability to different soils of the latter. Several methods of grafting are under test in a comparative way in connection with the same experiment. This work is for the present conducted at Washington, but will have distinct bearing on future developments in the work in the South Atlantic States and on the Pacific coast.

The experimental vineyards established in 1899 in North Carolina and Florida are now yielding very interesting and valuable results. In Florida the distinct superiority of stocks of the Rupestris type over those of the Riparia type on the sandy soils that are representative of a large portion of the State has been demonstrated. A number of Vinifera varieties in the collection at Earleton are considered exceedingly promising and worthy of commercial planting in a small way on suitable stocks in favorable locations in that State.

In North Carolina the behavior of the vines is less encouraging. This is probably partially due to the difficulty in securing skilled labor to care for the experimental vineyard, but appears to be chiefly due to the less favorable climatic conditions in that region during the season of 1901. Notwithstanding the unfavorable conditions which greatly lessened the output of native grapes in that section, a number of Vinifera varieties on resistant stocks have made good growth and have borne good crops for two years past, indicating that there is still a possibility of their successful culture in that section. Some of them have produced better crops and better fruit than either the Niagara or Delaware, the leading commercial varieties of the region, and have proved less subject to black rot than the Niagara.

In connection with the effort to develop choice table grapes in the South a considerable number of cuttings and vines of different varieties have been distributed to individuals and experiment stations. An investigation of the methods of manufacture of unfermented grape juice, its use, its effects on the human system, and its importance as a commercial product has been instituted. Rapid progress has recently been made in this line of manufacture, and unfermented grape juice is now an important article of commerce. Some changes

in the methods of manufacture appear to be necessary to insure a uniformly wholesome and reliable article. A bulletin on this subject has been prepared by Mr. Husmann, in which the methods of manufacture and care are briefly described and the more important steps necessary to insure good results are pointed out.

An experiment in the pot culture of Vinifera grapes under glass, both on their own roots and on resistant stocks, has been inaugurated in cooperation with the Horticulturist of the Bureau.

FRUIT DISTRICT INVESTIGATIONS.

The details of this work are in charge of Mr. H. P. Gould, assistant pomologist. The purpose of this investigation is to determine as accurately as possible the relative adaptability of commercial varieties of fruits to the important fruit-producing regions of the country. The work is being prosecuted through correspondence, field inspection, and various lines of cooperative work with growers. Arrangements have been made with more than 700 fruit growers, located in different sections of the United States and British America, by which the blossoming, vernation, and ripening dates of the important varieties of apples and peaches in the several localities are being recorded. These cooperative observers are also making definite reports on the important points of elevation, slope, character of soil, etc., where the trees are located, and it is anticipated that through this agency very valuable data can be assembled for comparison and correlation at the close of the season.

During the autumn of 1901 a careful orchard-to-orchard survey was made of an area in the Piedmont and mountain regions of Virginia from the Staunton to the James rivers, with a view to determining the orchard conditions there. A considerable portion of the area selected had been mapped by the Bureau of Soils earlier in the season, and careful comparative notes were kept on the relative behavior of varieties on different soils. It is intended to extend this work as rapidly as possible northward and southward from the area selected, which was mainly in Bedford County, Va., with a view to accurately mapping the areas found especially adapted to the culture of the apple and the peach. The region visited last year will be revisited during the present season, in order to verify or correct the original observations.

As the soil conditions, elevation, and exposure are important factors in determining the relative adaptability of varieties to locations, the soil maps of the Bureau of Soils and the contour maps of the United States Geological Survey, as well as the climatic records of the Weather Bureau, are found of particular value in this connection. This work is believed to be of distinct and far-reaching importance, as it is likely to exert a profound influence upon the commercial planting of the future. It is therefore desired to extend it as rapidly as possible to other important fruit-growing sections, and to place the results of the investigations in the hands of the public at the earliest possible date.

The phenological work above referred to is also of distinct importance, as the relative dates of blossoming and ripening, taken in connection with the dates of last killing frosts in spring and the first hard frosts in fall, frequently determine the adaptability of a variety to a particular site or section. It is realized that work of this character must extend over a considerable period of years to make safe con-

clusions possible, but it is believed that by personal conference with intelligent growers and by examination of the trees already in orchards valuable time can be saved and reasonably safe conclusions outlined much earlier than would otherwise be possible.

One of the most important features of the work of the past season was the discovery that a very large number of standard varieties of apples in the section which was investigated are grown under incorrect names. There can be no reasonable doubt that the correction of the nomenclature of these sorts through the instrumentality of field workers and specimens submitted to the Pomologist for identification will result in distinct benefit to the fruit growers of that region.

The orchards of suitably located experiment stations are being drawn upon to as large an extent as possible, both for phenological data and for records of experience with varieties. The private varietal collections of large commercial growers are also being utilized in this way in several States.

CURRENT WORK.

Work for the current year is proceeding somewhat closely along lines followed during the year just past. A larger appropriation has made possible an extension of several lines, though the number of problems demanding early attention is so great that the funds provided are found insufficient. The general routine work of the office may be expected to show a steady and rapid increase, as the several lines of field investigation bring a larger number of fruit growers into touch with the Department in each successive year. The fruit marketing and storage work will be pushed to the fullest possible extent with the means available. The principal experimental export work contemplated for the year deals with summer and winter apples and with peaches, summer and late fall pears, pineapples, and cranberries, among fruits; and sweet potatoes and winter squashes, among vegetables. The primary objects sought to be determined in these shipments are:

(1) The practicability of delivering these products in foreign markets in sound condition.

(2) The probable demand for them in those markets.

(3) The prices obtainable and the relative cost of packing and transporting the products.

Single shipments of a particular fruit are, of course, insufficient to base conclusions upon, and repeated shipments of each fruit tested are being planned in cooperation with growers and dealers. Studies of the practicability of exporting fruit that has been held for a considerable period in refrigerated storage will also be made.

In fruit storage a number of interesting and very important problems are under investigation. One of these relates to the control of barrel scald in apples through proper methods of picking, packing, forwarding, and storage. Another relates to the relative storage durability of apples grown on young as compared with old trees, sprayed with unsprayed trees, cultivated with uncultivated soils. Other problems relate to the storage durability of pears and peaches and the best methods of picking, packing, and forwarding these fruits to storage, as well as the question of the best temperatures in which to store them. The various interests involved, including the fruit growers, transportation companies, and warehousemen, are cooperating with the Department in a gratifying way, and important and valuable results are anticipated from this line of work. The

viticultural investigations planned for the future comprise the maintenance of the existing stations and experimental plots, together with the thorough investigation of the native grape production in the Southern States, and a preliminary survey of the important commercial grape sections of the Pacific coast. The fruit district investigations will be extended to cover a larger area, and it is expected that in addition to the work now under way in the Allegheny Mountain region work will be begun in the Ozark region of Missouri and Arkansas.

HORTICULTURAL INVESTIGATIONS.

GARDENS AND GROUNDS.

This work is in charge of Prof. L. C. Corbett, the Horticulturist of the Bureau, who submits the accompanying statement of results accomplished during the year:

The area occupied by the gardens and grounds of the Department of Agriculture comprises nearly 33 acres. A large portion of this reserve is park area, planted for the most part with native ornamental and economic trees and shrubs, arranged in groups according to their botanical affinities as well as to conform to the principles of landscape gardening. The care and maintenance of a park area of this extent requires careful judgment and skill on the part of the superintendent as well as the labor of a considerable force of workmen.

LAWNS.

The maintenance and reconstruction of lawns on areas either fully exposed to the sun or those densely shaded by overhanging branches is a problem of interest to every place holder as well as park superintendent. Because of the exceptional soil conditions of the District of Columbia the maintenance of a creditable lawn is rendered difficult. In order, therefore, to throw some light upon this problem, different methods of preparing the soil and of sowing the seed, as well as the time of seed sowing, are being tested on the grounds. In this connection, the vital points of time and manner of applying water to the lawns are receiving attention.

ECONOMIC PLANTS UNDER GLASS.

In addition to the outdoor plantation of trees and shrubs, a large collection of tropical and subtropical plants is maintained under glass. As opportunity and means will permit, it will be the aim to bring together in this collection all the economic plants of the dependencies of this country, as well as from various horticultural regions of the United States.

FOREIGN GRAPES.

In addition to the general collection of economic plants above referred to, a house 26 by 136 feet in extent is devoted to foreign grapes, representing among its varieties some of the best wine, dessert, and raisin grapes of Europe. This collection, although a valuable one, contains many sorts which during late years have been supplanted by more valuable new ones, and it is proposed to modify the present collection by eliminating some of the less valuable and

substituting therefor the newer and more desirable sorts not only for the purpose of showing the best that Europe has to offer, but in order that we may test them under house conditions in the United States. The collection will be modified in another important feature by grafting a large number of new sorts on the vines already established, the object being to test the various methods of top grafting the grape and at the same time double or treble the existing variety collection without extending the area.

The problem of growing grapes in pots, as a catch crop for houses devoted to the forcing of flowers and vegetables during the winter season, is now receiving attention.

TROPICAL FRUITS.

In addition to the grapery, there is upon the grounds a house, 24 by 101 feet in extent, devoted to the growth of subtropical tree fruits. In this collection are a number of sorts of oranges, the most noteworthy among which is a Bahia or Washington navel tree, one of the original importations upon which the whole citrus industry of California has been built up. The collection also contains lemons, grape fruit or shaddocks, and mandarin and tangerine oranges from Japan. There are also two bearing guava plants, one bearing loquat and a large collection of the choicest foreign varieties of this fruit brought in through the office of Seed and Plant Introduction.

ROSES.

Another house, 24 by 101 feet, is now given up to the culture of roses. The work here consists of a study of the best methods of propagating the rose. This involves a test of the comparative merits of flowering and blind wood, as well as a study of the best character of wood of each sort, the best season of the year for making cuttings for continuous bloom, as well as an investigation of the comparative merits of various devices and mediums in which to strike the cuttings. The value of crown and root-grafted roses is also made a part of this study. As an incident to the rose work, the development of new forms is constantly under way.

CARNATIONS.

With this valuable commercial plant the work is being pushed along on much the same plan above outlined for the rose. New methods of culture which shall secure earlier, larger, and more abundant bloom for a given area are being tested. The results indicate that much less loss from disease will follow than when ordinary field culture is practiced. A more extended test of the plan under varying conditions is contemplated before it is recommended for commercial concerns. For the amateur, however, it will prove far superior to the ordinary plan now in vogue. As a side issue to the cultural work, new seedling sorts are constantly being developed, with the hope of securing something which shall be superior to the sorts now in general cultivation. The importance of the work along floricultural lines is shown by the commercial returns. Cut flowers wholesaled in the city of New York alone during 1901 amounted in value to $2,750,000, and it is safe to say that one-half of this sum was expended for roses and carnations. The value of these crops would justify the expenditure of an amount greater than is annually set apart for the entire maintenance of the Experimental Gardens and Grounds.

EASTER LILIES.

It is estimated that about $250,000 are annually expended in the purchase and forcing of the Easter or Bermuda lily. Yet growers complain that there is no profit in the business, due mainly to the failure of the bulbs to produce satisfactory bloom. As high as 40 per cent loss has been reported, while 20 per cent is about the average. Notwithstanding these heavy losses, the demand for the lily forces the growers into cultivating it in order to hold their trade, even though this branch of the business is carried on at an actual loss. The work which the Department now has under way bids fair to solve this difficulty. If success is ultimately attained, this hazardous branch of the florist's business will be made remunerative, and lily forcing as an industry will grow in proportion to the increment of profit which can be shown.

VIOLETS.

As a result of the demand for the violet and the price which it commands in the market, nearly every person interested in a general supply of cut flowers grows or attempts to grow violets, while many others make violet culture their specialty and main dependence. In consequence of the many failures which are annually reported in this line, the work of the Experimental Gardens and Grounds has been extended to include a test of the methods of culture and varieties of violets best suited for commercial growing. As a beginning in this direction two houses have been erected and so arranged that the various conditions of soil, heat, and moisture demanded by the violet can be studied. A variety collection, comprising all of the commercial sorts of both the United States and Europe, has been brought together for the purpose of determining their fitness for commercial work and their value as parent stock for new varieties.

The work along floricultural lines will be broadened and developed as rapidly as the means of the office will permit. This line of endeavor, while a decided departure from the former work of experimental gardens and grounds, is justified by the enormous outlay of capital involved in the growth and forcing of flowers, and also from the fact that the business is general, scattered through every State and Territory of the Union, though there is scarcely enough in any one State to justify any considerable outlay for such work by the State experiment stations. The problems and difficulties of the florist, if they are to be solved, must be taken up and worked out at the experimental gardens.

COOPERATIVE WORK.

The plan of cooperation outlined in the report of the Experimental Gardens and Grounds for the year ended June 30, 1901, is being carried out as rapidly and fully as the work of the Department demands and the facilities will permit.

GRASS GARDENS.

An area upon the grounds has for several years been set apart for the use of the Agrostologist. The use to which the area has been devoted is that of growing various meadow and pasture grasses, together with a limited number of the more important forage crops. Upon another area there has been planted in an attractive manner a

border of the various ornamental grasses, which serve well to illustrate the value of these plants for decorative purposes. These two plantations form educational exhibits of more than ordinary interest.

PLANT INFIRMARY.

In order to facilitate the work of vegetable pathology, one of the plant houses of the range upon the grounds is devoted to plants grown for the purpose of studying the diseases which affect them, as well as the physiological influence of these diseases upon the health, vigor, and fruitfulness of the host plant. For want of a better term this house has been designated the infirmary.

SEED AND PLANT INTRODUCTION.

Annually a large variety of plants of value are brought to the propagating houses of Gardens and Grounds through the activity of the office of Seed and Plant Introduction. Usually these plants, seeds, and cuttings are sent in small quantity—sometimes a single scion or cutting forms the only starting point—and as these are too frequently in poor condition after a journey perhaps extending halfway around the world, it requires the utmost care, skill, and judgment to insure the growth of such material. Mr. George W. Oliver, the expert in charge of this branch, has been exceptionally successful with this material, and a great majority of the importations have been preserved and increased. Among the more noteworthy importations of the year are a large and choice collection of loquats from northern Africa. Several hundred plants have already been secured from this stock, and the work is still in progress. These sorts are said to be much superior to those now cultivated in the United States. If the varieties prove equal to the claim made for them by our foreign agents, the loquat industry, which is already of decided economic importance, will be entirely revolutionized and made much more remunerative.

The question of the best method of propagating these foreign fruits is one of great importance, for the commercial success of an industry frequently hinges on this point. Up to the present time the difficulties connected with the successful propagation of the more desirable sorts of the mango have defeated the successful commercial cultivation of this fruit in America. Our work with this plant leads us to believe that the difficulty has in great part been overcome and that desirable sorts will soon replace the indifferent seedlings.

In addition to the loquats above mentioned extensive additions have been made to the collection of foreign grapes, figs, and citrus fruits, over 50 varieties of the latter having been successfully propagated and distributed during the year.

The candle nut (*Aleurites triloba*) has been grown and distributed in those portions of the United States and the Hawaiian Islands considered best suited to its development. If a success, this will add another nut of economic value to our already long list.

The carob, or St. John's bread, one of the drought-resisting trees of the Orient, has been successfully propagated in large numbers, about 10,000 young seedlings having been grown. It is believed that this tree will prove of special value as a shade and ornamental tree throughout the dry regions of the Southwest, particularly through southern California, Arizona, and New Mexico.

The jack fruit (*Artocarpus integrifolia*) has been propagated and disseminated in southern Florida, southern Texas, and southern Cali-

fornia. While this species is said to produce a fruit less palatable than the bread fruit (*A. incisa*), the seeds when roasted have the flavor of chestnuts.

PLANTS PROPAGATED, DISTRIBUTED, ETC.

During the year there has been a very great increase in the number of plants propagated and distributed by the Gardens and Grounds. The following shows the character and magnitude of this branch of the work:

PLANTS PROPAGATED DURING THE SEASON OF 1901 AND 1902 FOR USE ON THE GROUNDS AND FOR DISTRIBUTION.

Name.	Number of varieties.	Number of plants.	Name.	Number of varieties.	Number of plants.
Alternanthera	3	3,872	Grapes (foreign)	67	691
Amaranthus	1	1,550	Lemon	1	1,373
Abutilon	2	800	Mignonette	1	547
Ageratum	1	500	Marigold	1	1,039
Acalypha	1	473	Nasturtium	1	213
Ampelopsis vine	1	3,267	Olive	9	2,307
Asters	2	2,384	Pandanus	1	147
Antirrhinum	2	563	Pansy	3	2,492
Begonia	9	742	Phlox	2	857
Coleus	4	7,100	Pyrethrum	1	229
Celosia	1	532	Roses	15	5,342
Chrysanthemum	123	1,694	Ricinus	3	764
Carnation	4	3,847	Poppy	2	691
Canna	4	697	Petunia	2	327
Centaurea	1	2,731	Salvia	2	2,749
Cineraria	1	1,973	Swainsonia	1	352
Cosmos	1	763	Stevia	1	371
Clematis	1	10,700	Sedum	1	2,213
Dahlia	6	379	Shrubs	13	14,416
Dianthus	2	2,542	Tobacco	1	4,500
Euonymus	1	1,739	Tea	5	29,341
Fuschia	7	312	Vinca	2	1,243
Ferns	4	519	Vines	17	2,165
Geranium	5	3,857	Verbena	4	2,704
Guava	2	291	Miscellaneous	70	1,953
Heliotrope	1	1,209			
Iresine	2	3,734	Total		137,796

ANNUAL FLOWERING PLANTS ON GROUNDS.

Aster	780	Cosmos	270
Dahlia	85	Heliotrope	187
Dianthus	963	Mignonette	547
Feverfew	200	Marigold	250
Gladiolus	1,020	Pansy	1,400
Rudbeckia	600	Phlox	325
Roses	1,800	Poppy	250
Antirrhinum	213	Petunia	72
Ageratum	100	Swainsonia	293
Begonia	100		
Celosia	232	Total	12,387
Carnation	2,700		

BEDDING PLANTS ON GROUNDS.

Abutilon	750	Salvia	973
Acalypha	432	Amaranthus	375
Alternanthera	2,740	Centaurea	756
Canna	654	Cineraria	634
Coleus	2,300	Sedum	934
Cuphea	50	Verbena	300
Geranium	1,200		
Iresine	650	Total	12,748

DISTRIBUTION OF PLANTS, BULBS, ETC.

During the year the customary distribution of plants has been maintained, the records showing that the following sorts, to the number indicated, have been distributed:

Bedding plants	9,708
Bulbs:	
Congressional distribution	98,874
Miscellaneous distribution	25,520
Camphor plants	850
Chrysanthemums	98
Citrus trifoliata	3,209
Coffee	16
Dracaena	88
Ferns	173
Fig cuttings	2,150
Grapevines:	
Congressional distribution	14,920
Miscellaneous distribution	1,085
Greenhouse plants	331
Olive plants	568
Palms	556
Privet cuttings	4,850
Roses	806
Rubber plants	561
Shrubs	1,330
Strawberry plants:	
Congressional distribution	53,780
Miscellaneous distribution	3,643
Tea plants	4,013
Trees:	
Congressional distribution	22,319
Miscellaneous distribution	1,866
Vines	256
Miscellaneous plants	3,532
Total	255,102

PLANS FOR FUTURE WORK.

Every effort will be made to render the Experimental Gardens and Grounds an aid to horticulturists of all classes. The floricultural work with lilies, roses, carnations, and violets now under way will be continued until decided results have been secured. New work, looking to the betterment of the florist's conditions, will be taken up as rapidly as space and force will permit.

Improved methods of propagating plants, particularly those which are difficult and uncertain, will be continually under way. A plan to establish and maintain a garden in which wild plants possessing merit or value, either for ornamental, medicinal, or other economic purposes, has been evolved and will be put into operation during the current year. Prof. Charles F. Wheeler, of the Michigan Agricultural College, has been placed in charge of this novel feature of the development of the grounds. His attainments along this line assure a speedy and valuable development of the idea. The wild garden will serve not only to illustrate the value of our native plants for cultural purposes, but they will be so grouped as to illustrate their value for landscape effect. An important feature of the work will be to determine the methods of propagating and cultivating these wild plants, in order that success may follow their introduction into improved areas.

The grape investigations now under way will be continued and further extended.

The system of heating the greenhouses upon the grounds will be changed from the old plan of hot water in closed circuits and a boiler for each house, to steam from a central heating plant.

The arrangements of the plants in the economic collection will be remodeled so as to be more instructive, and so labeled as to present to the visitor in brief and concise form that feature for which each plant is specially valued.

ARLINGTON EXPERIMENTAL FARM.

With a view to making the farm of the greatest value to the entire Department, the general management was placed under Prof. L. C. Corbett. The work of the farm in general and of gardens and grounds is closely related.

WORK OF THE YEAR.

The area known as Arlington Experimental Farm was originally a part of the estate now occupied by the Arlington National Cemetery. This land lies on a river beach between the Potomac River and the Alexandria and Mount Vernon turnpike. The soil, while not rich, is in good mechanical condition and responds readily to cultivation and fertilization, and is easily drained either by surface drains or by tile, as the contour is irregular and provides readily for the removal of suface water.

DRAINAGE.

Large open ditches have been constructed which traverse the farm so as to catch and remove the water which naturally drains upon it from the Arlington National Cemetery, and provide outlets for the tiled drains which have been made tributary to them. Up to the present time about one mile of open ditch has been constructed and nearly three carloads of tile laid. The work of underdraining will be continued until the farm is satisfactorily drained.

SURVEY.

Previous to permanent planting the farm is being surveyed in such a manner that permanent plantations may be made upon land more suitable to the particular crop to be planted without having intervening places occupied by similar crops, and yet so that the permanent planting will conform to the general plan or scheme of development for the entire area.

The plan being carried out is to run driveways parallel with the boundary of the National Cemetery at intervals of 8 rods, thus giving the plats, which are one-twentieth acre in area, 1 rod of frontage along the driveways. The twentieth-acre plat is considered the unit for all plat work.

In addition to this survey a topographic survey is being made which shall note the contour and the position of the open as well as the tile drains. As soon as this topographic survey shall be completed a soil survey of the area is contemplated. It is hoped to make this in great detail, in order that after the expiration of a series of years the changes which have been effected by various plans of soil

improvement work which are being devised may be determined by repeating the soil survey.

If the Rothamsted experimental area had been carefully surveyed previous to inaugurating the crop experiments which have attracted so much attention, the present condition of the soil, as compared with its condition before the cropping work was begun, would show much more clearly the results of the long test.

It is hoped by carrying out the above-mentioned plan to overcome this difficulty in our future work.

PREPARATORY TREATMENT.

The Arlington Farm, previous to its acquisition by the Department of Agriculture, had been used for many years as a grazing area for the horses and mules not in service belonging to the War Department. In general it was fairly well covered with a bluegrass sod, but many shrubs and trees had grown up to interfere with cultivation. The trees and shrubs were removed and the sod plowed and put into condition for the reception of cowpeas or buckwheat, according to the season of the year when the work was completed.

The area sown to cowpeas was plowed in the fall and allowed to lie fallow during the winter. The area planted in buckwheat was seeded to rye by running a disk harrow over the buckwheat and drilling the rye upon the ground thus prepared, without replowing. In the spring of 1902 the rye was turned under about the time it came in head and the ground sown with cowpeas.

By this method it is hoped to secure a considerable amount of decomposed organic matter, to increase the water content of the soil, and to enhance its power for holding the plant foods applied in the form of commercial fertilizers.

PLAT WORK.

About 40 acres of land which in 1901 was planted in cowpeas is this year being devoted to plat work. The plats have been laid off as above described and are planted to various crops according to the line of work under way. Some 4 acres are devoted to nursery purposes, including seedling forest trees, such as oaks, ash, maple, etc.; fruit trees, such as apples, pears, plums, cherries, and peaches, together with about three-fourths of an acre with strawberries.

EXPERIMENTS WITH VEGETABLES.

Experiments with tomatoes, muskmelons, watermelons, and celery have been inaugurated this season.

COOPERATIVE WORK.

In cooperation with the office of Grass and Forage Plant Investigations there is growing upon the farm a large collection of the annual forage crops, including cowpeas, soy beans, millet, nonsaccharine sorghums, rape, various clovers, alfalfa, and vetches, including in all 100 varieties of cowpeas and soy beans.

PLANT-BREEDING EXPERIMENTS.

In cooperation with the plant-breeding laboratory there are growing upon the farm six isolated plats of corn of different parentage,

for the purpose of growing these varieties true to type, as well as affording opportunity for artificial cross-pollination.

One area, consisting of 20 acres, is devoted to a test of the value of seed of a single variety treated in various ways as regards curing.

PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

In connection with the work of the Pathologist and Physiologist, two areas, about 1 acre each, are devoted to a large collection of leguminous plants, including all those which are extensively grown for forage and soiling purposes in the United States, as well as a number of rare European and Oriental sorts.

The purpose of this work is to study under field conditions the behavior and value of various nitrifying organisms suited to the different crops.

BOTANICAL INVESTIGATIONS.

In cooperation with the office of the Botanist, work has been undertaken to determine the best methods of propagating and cultivating the various economic plants which are used as a basis of the drug supply. This line of work has received comparatively little attention, and practically nothing is known regarding the methods of propagating, cultivating, harvesting, and curing these plants in order to secure the best results from them for commercial purposes.

POMOLOGICAL INVESTIGATIONS.

In cooperation with the office of the Pomologist, land is being prepared and trees grown for the planting of extensive variety orchards, which shall serve as a basis for verifying specimens submitted to the Pomologist for identification, as well as a source from which to secure authentic propagating material for distribution to experiment stations and fruit growers. As a step toward the carrying out of this plan over 200 varieties of apples have been grafted during the past winter, and arrangements are being made to bud as many varieties of peaches during the month of August.

While some time will be lost in growing trees from root grafts or from buds, rather than buying them ready grown from the nurserymen, it is believed that in the long run time will be saved by the method adopted, because scions and bud wood will be secured from trees known to bear fruit true to name.

PLANS FOR FUTURE WORK.

The work of mapping the area and of making the soil survey previously mentioned will be continued during the current year. A barn of sufficient dimensions to house the stock and implements necessary to carry on the work of the place will be erected, and the permanent planting of orchards for variety as well as cultural purposes will be begun. It is the aim in the cultural work with orchard trees to study upon the broadest possible plan soil improvement by the use of leguminous crops in the way of cover crops or green manuring.

The questions of pruning, fertilization, and spraying to combat insects and fungus diseases, as well as to maintain the vigor of the plants, will be inaugurated upon the cultural areas.

VEGETABLE WORK.

Up to the present time comparatively little attention has been given to cultural work with vegetables at the Department; but now that we have sufficient and suitable land for this work it is proposed to devote as much energy to the study of the best methods of propagating, cultivating, and harvesting such crops as potatoes, tomatoes, peas, beans, celery, sweet potatoes, cabbage, cauliflower, etc., as the appropriation to the farm will admit.

The location of the experimental farm, near one of the greatest centers for the commercial production of the various market-garden crops, warrants us in undertaking this work on a somewhat extended scale. Then, too, the difficulties with which the commercial growers of these staple crops have to contend is a further evidence of the importance of this work.

Another line of work which we hope to take up as a demonstration experiment is the reclaiming of a large tract of rich alluvial bottom land, which is now submerged at high tide, but which is quite dry at low tide. It is proposed to reconstruct a levee which formerly existed, and thus shut out the tide, and to so open drains that the surface of the ground shall be easily and quickly cleared of water. Pumping facilities are to be provided in order to maintain the water in the ditches at proper depth below the surface to insure success with such crops as celery, onions, cabbage, etc.

There are thousands of acres of land similar to that belonging to Arlington Farm along the banks of Chesapeake Bay and its tributary rivers. If it can be demonstrated that at a small outlay these lands can be reclaimed and made profitable when devoted to trucking crops, it is believed that the end will justify the undertaking.

IRRIGATION.

Upon the upland of the farm it is desired to establish a plant of sufficient capacity to demonstrate the efficacy and value of irrigating land devoted to fruit and garden purposes in a region subjected to spring and fall droughts of considerable duration. This question has long been agitated by market gardeners, some of whom have the scheme carried out in a good working manner; but up to the present time this question has not been taken up by the Federal Government or by the State experiment stations.

COOPERATIVE TESTING STATIONS.

As soon as the horticultural work of the Department can be placed upon a basis comparable with that of the other offices of the Bureau, that is, so as to permit of conducting investigations other than those upon the Experimental Gardens and Grounds and at the Arlington Farm, a series of cooperative testing stations should be established to work in conjunction with the above-named divisions. In general, arrangements can be perfected with the authorities of the several Federal experiment stations located in the various States, but in such work it is only fair, when the land and equipment are supplied, that we should provide seed, plants, and labor for carrying on such investigations.

The need for such testing stations becomes apparent in view of the value of the material annually brought to this country through the

office of Seed and Plant Introduction. The miscellaneous distribution of this material may result in finding now and then the proper locality for a particular plant, but in general the labor and expense of importing and propagating the material will be lost unless provision can be made for distributing this material to those of the proposed cooperative test stations best located for the success of the plant in question, and then to be under the immediate supervision of a skilled Department gardener who is able to give the plant such treatment as will be most likely to insure its growth. As the matter now stands the arrangement is not perfect, much valuable material being lost because the persons receiving it know nothing of its care and culture.

Such cooperative stations would further the work of studying the adaptation of horticultural varieties of both fruits and vegetables to the several life zones of the country. Such testing stations would prove of immense value as a guide to those in charge of the distribution of valuable seeds, plants, bulbs, etc., as the sort best adapted to a region would be learned and the distribution arranged accordingly. The geographical limitations of varieties would thus be determined and the influence of soil and climatic conditions brought out.

Should the plantations at these stations be extended to include fruits, the work of the Pomologist would be placed upon a much more satisfactory basis than at present. The changes in varieties induced by soil and climatic conditions would serve to prevent much of the confusion which results from the remaining of old sorts modified by new environments.

The importance and desirability of such a plan of cooperation between the Horticulturist in Washington and an experimental station located in each of the leading fruit-growing, seed-growing, and trucking regions of the country is obvious, and it is believed that the horticultural interests of the country can best be served by cooperative arrangements along the lines and for the purposes above mentioned.

TEA GROWING.

The work on the growing of American tea has been continued during the year at "Pinehurst," Summerville, S. C., in cooperation with Dr. Charles U. Shepard. For a number of years Dr. Shepard has been devoting his entire time to the problem of successful commercial tea culture in this country, and has carried on at Summerville an interesting line of experiments which have served to settle many questions in regard to this crop, heretofore little understood. With a view to encouraging this industry, the Department undertook cooperative work with Dr. Shepard a few years ago; prior to that time he had borne all the expense himself. It is now known, of course, that many of the earlier efforts in the matter of planting and handling tea were mistakes, but these could not well have been determined except by actual experiment. It has been shown, for example, that, so far as conditions at Summerville are concerned, the best teas and most prolific crops are not grown, as was supposed, on the high ridges, but are produced in the low places commonly known as the "pine woods ponds." There are several of these places on Dr. Shepard's plantation, where the soil is of a rich black loam, and where the tea makes excellent growth and gives a heavy yield. The plantings made on the higher ground have been more or less injured every year by

serious washing of the soil and the consequent leaching out of fertilizing elements.

There are now practically 100 acres in the tea gardens at Summerville, the various gardens being considerably scattered in order to obtain definite facts in regard to the effects of different soils, methods of cultivation, etc. Much attention has been given to testing teas from different regions, the object being to determine the varieties which give the most satisfactory results. Since the larger portion of the gardens has come into full bearing much detailed information has been given to work which would determine the best possible methods of reducing the cost of production. Careful attention has been paid to all the details connected with the picking of the tea, pruning, fertilization, cultivation, etc. By such methods it has been practicable to essentially reduce the cost of the different operations during the past two years, and of course this will add to the profits of the industry. In addition to careful details which have been followed in the field, much attention has been given to the improvement of factory methods with a view to the production of a better article. New machinery has from time to time been added, with the result that the increased yield has been handled quite satisfactorily. By means of apparatus, devised for the most part by Dr. Shepard himself, green teas of good quality are now being made. It has been found practicable also during the past year to materially improve the finish of the tea through knowledge gained in connection with the handling of the product. With a view to obtaining some information that would be of value in connection with the handling of tea, some special studies on fermentation were made during the year. This work was carried on by Dr. Rodney H. True, and some interesting results were obtained. It is too early yet to make any definite announcements in regard to what has been accomplished in this direction, but the results were of such a nature as to give promise of much encouragement for the future.

From the outlook at the present time the yield of dried tea from the Summerville gardens will amount to about 9,000 pounds for the year. This is about double the yield of the preceding year, and shows that the gardens are rapidly coming into bearing, and that with no setbacks the yield will steadily increase for another year or two. Owing to the encouraging outlook at Summerville, a tea plantation has been started by private individuals near Charleston, on lands formerly used for the growing of rice. The experiments at Summerville have shown conclusively that the tea plant would, in all likelihood, succeed on such soil, especially as water for irrigation purposes is readily available. The great advantages to be found here lie in the fact that no expense is involved in the matter of removing heavy timber. At Summerville, when the earlier gardens were put out, the expense of clearing the grounds was from $300 to $400 per acre, making the cost for all preparation exceedingly heavy. About 250 acres have been put out on the Charleston plantation, and more will be planted as rapidly as the plants are available.

One rather serious drawback to the extension of the tea gardens is the difficulty of obtaining, without very heavy expense, proper tea seed. Tea seed at the present time costs from $40 to $50 a bushel, and it must nearly all be imported. Some of the best and strongest tea plants have been grown from tea seed produced in this country, but of course the production of such seed is limited, owing to the fact that seed-bearing plants are scarce.

FUTURE PLANS FOR TEA WORK.

Owing to slightly increased appropriations, plans have been made for extending the tea work into other parts of the South. The work at Summerville will be continued and the main lines undertaken will be for the purpose of obtaining additional information in regard to the improvement of the product by factory methods, the chemical and physiological study of the leaf during various operations involved, and the testing of such machinery as it is believed may prove of advantage in facilitating the work and giving a better finish to the product. Plans have also been made for some work at Summerville to determine the practicability of growing tea from cuttings. Practically all the plantations are now from seed, and little or no attempt has been made to increase the forms which have given the highest grades of tea and the best yields. With a view to encouraging the growth of this crop in other parts of the South, plans have been made for establishing a tea garden either in Texas or Louisiana, preferably the former State, if suitable conditions in the matter of labor, soil, and rainfall can be secured. The primary object of this work will be to demonstrate the practicability of commercially growing tea. With the funds available it is hoped to secure, through cooperation with State authorities, a tract of land which will enable the Department to establish gardens to the extent of about 100 acres; 50 acres will be put out at once, and increased from time to time as the work progresses. The point of location has not yet been determined upon, as it is important to secure a combination of factors, and this can only be done through a careful field investigation. This work is now under way, and as soon as a location is determined upon and the proper cooperation is secured the gardens will be established. It will be two years, possibly longer, before the necessity for factory work will arise. In the mean time the details of the gardens will be looked after by an expert who has had special training in tea growing, and it is hoped sufficient aid for the ordinary labor connected with the work may be secured through cooperation with interested private individuals.

Whether or not tea growing in this country can be made a commercial success will depend, in large measure, on most rigid attention to details connected with every phase of field and factory work. It is not expected that any large profits can be made from this industry, but it is believed that by proper and judicious management sufficient profit will result to encourage the planting of the crop in many parts of the South. The primary object in all such work is not so much to secure large profits as to point out the feasibility of diversifying crops, a matter which needs special attention on the part of those who have been accustomed to depend largely on one staple.

CONGRESSIONAL SEED DISTRIBUTION AND FOREIGN SEED AND PLANT INTRODUCTION.

CONGRESSIONAL SEED DISTRIBUTION.

The plans set forth in the last report of this Bureau outlining the proposed changes in the methods of handling the Congressional distribution of seeds and plants were put into operation with beneficial results. Notwithstanding the fact that the appropriation for seed was nearly doubled, the increased work was handled without serious delay or loss of time. The statement on the next page shows the seeds received, tested for vitality and purity, packeted, and mailed.

Miscellaneous vegetable seed	packets	37,299,816
Miscellaneous flower seed	do	1,368,000
Tobacco seed	do	100,000
Cotton seed	1-peck packages	10,000
Sugar-beet seed	2-pound packages	6,500
Sorghum seed	2-quart packages	9,127
Alfalfa seed	2-quart packages	1,300
Alsike clover seed	1-quart packages	7,062
Crimson clover seed	2-quart packages	9,750
Velvet bean seed	2-quart packages	4,312
Kafir corn seed	2-quart packages	3,625
Brome grass seed	2-quart packages	1,500
Lawn grass seed	½-pound packages	20,000
Miscellaneous seed, estimated	packets	50,000
Total packets and packages		38,890,992

The details of the work connected with the distribution of small trees, grapevines, strawberries, and other miscellaneous plants have already been given under the report of the work of the office of the Horticulturist.

The securing of all miscellaneous vegetable and flower seeds and the packeting and mailing of the same for the Congressional seed distribution were provided for in a contract with the Henry Philipps Seed and Implement Company, of Toledo, Ohio. The contract provided that all seeds should be packeted, then put up or assembled in packages of five packets each, and mailed under the direction of the Department. Besides this contract arrangements were made for the handling of cotton seed, tobacco seed, lawn grass seed, sugar-beet seed, sorghum seed, forage-crop seed, bulbs, trees, grapevines, and plants by the various officers of the Bureau. In the case of all these special seeds efforts were made to secure varieties of promise and to place them in localities where they would improve the agricultural conditions prevailing therein. There was appropriated for this work the sum of $270,000, which was expended as shown in the following summarized statement:

Vegetable and flower seed contract with the Henry Philipps Seed and Implement Company	$180,011.80
Tobacco seed	1,495.65
Cotton seed	2,086.50
Sugar-beet seed	1,162.06
Sorghum seed	669.58
Alfalfa seed	437.00
Alsike clover seed	1,834.00
Crimson clover seed	1,677.70
Velvet bean seed	370.00
Kafir corn seed	352.20
Brome grass seed	177.50
Lawn grass seed	1,050.00
Bulbs	2,772.82
Trees	1,100.00
Strawberry plants	269.00
Grapevines	434.50
Seeds for miscellaneous special orders	1,000.00
Seeds for Alaska	454.80
Seeds for cooperative work carried on by the Agrostologist	442.50
Miscellaneous seeds	715.38
Total for seeds and plants	198,512.99
Labor in Washington	41,323.66
Foreign Seed and Plant Introduction, less salaries in Washington	12,270.54
Miscellaneous expenses	13,588.23
Balance unexpended to date	4,304.58
Total	270,000.00

In the distribution of all seed a special effort was put forth to meet the needs of different localities. To this end the country was divided into districts for each class of seed, and only such seeds were sent into each district as seemed likely to succeed and improve the agricultural conditions therein. Owing to the fact that the contract for the miscellaneous vegetable and flower seed was awarded before the work was assigned to this Bureau, very little change could be made in the matter of adapting the varieties to particular localities. A general plan with this object in view, however, was carried out, and enabled us to expedite the work in a number of ways. In the distribution of the tobacco, cotton, sugar-beet, sorghum, and forage-crop seed, special arrangements were made with a view to securing new and valuable types, and these were sent out under the care of an officer of the Bureau familiar with the crop in question. Thus the securing and distributing of the cotton seed were placed in charge of Dr. H. J. Webber, who selected the varieties, determined where these varieties should be sent, and prepared the necessary instructions for the planting and care of the crop. Instead of sending small packages of this seed to growers, a sufficient quantity was forwarded to enable them to make a test, and arrangements were made for making records on the growth of the crop and the forwarding of these records to the Department. In the distribution of forage-crop seed the country was districted to meet the requirements of each case. Thus brome grass was sent into the Northwestern States, alfalfa to the Southwest, the velvet bean into the extreme South, and the other crops after the same general plan. This work proved very satisfactory, and the results show that the crops distributed have been serviceable in a number of ways. As a part of this general plan, special arrangements were made for testing certain kinds of seed on a more extensive scale. Thus, in order to encourage the growing of alfalfa, arrangements were made through the Representatives of certain States to furnish the names of several reliable men in each Congressional district who would plant and care for an acre or more of the crop under the direction of the Department. The seed was furnished, directions were given for planting, and a system of records devised which would enable us to follow the work. These demonstration experiments are proving valuable in showing the practicability of extending the cultivation of crops whose value, so far as known, is confined to comparatively limited areas.

FOREIGN SEED AND PLANT INTRODUCTION.

During the past year the Department has pushed forward the lines of work already begun, especially the rice, wheat, and date introductions, which were mentioned in our last report. The efforts spent on the introduction of Japanese rice and macaroni wheat have been more than justified by the splendid results attained thus far, but it is necessary to press these lines forward to completion at every point, so as to leave these industries in a position where they may take care of themselves and hold the ground that has been gained.

THE INTRODUCTION OF VALUABLE CEREALS.

The work of establishing new varieties of cereals through introduction from foreign countries has been carried on in close cooperation with the office of Vegetable Pathological and Physiological Investiga-

tions of this Bureau. The need of the introduction of certain varieties of grain was, in the first place, actually suggested in connection with the investigations with cereals being carried on by that office. After such varieties are once introduced and found by two or three years' experiment to be adapted for cultivation in this country, the further work with these varieties, their relations to soil and climate, selection of the best sorts, etc., is continued chiefly under the direction of the Pathologist and Physiologist. Therefore, in cases where certain data if given here would exactly duplicate statements made in the report from the office of Vegetable Pathological and Physiological Investigations, the reader is referred to the report of the cerealist of that office.

History.—In connection with the Department work on cereals, it became evident some years ago that anything approaching the perfection desirable in the way of rust resistance, hardiness, earliness, etc., did not exist among the varieties of wheat and other cereals then grown in this country. At the same time these experiments seemed also to show that varieties superior in these respects might be obtained in foreign countries. The section of Seed and Plant Introduction, therefore, in 1898–99, in cooperation with the cerealist, began the work of introducing better varieties of cereals, and while the particular qualities already mentioned were kept in mind, a special feature was also made of securing varieties that might be adapted for cultivation in the large semiarid prairie regions of this country.

Methods.—The plan adopted in the introduction of these varieties was to first secure a limited amount of seed of desirable varieties and to distribute this in small quantities to the experiment stations in the districts where it was likely to succeed. Also, certain varieties which if successful would establish an entirely new industry in this country, were imported and tested in the same way. If these careful experiments on a small scale justified further importations, the seed was purchased in larger quantities and distributed to selected farmers throughout the region to which the varieties were adapted. If the results of these experiments were favorable and thereby confirmed the conclusions from results obtained by the experiment stations, the varieties were considered to be thoroughly well adapted to the country, and so far as the section of Seed and Plant Introduction was concerned the work was considered completed. The crops produced by these farmers served as nuclei from which further distribution of seed was afterwards made. In accordance with this plan, there was never a possibility of the waste of a large amount of seed, since it was only obtained in small quantities until it had been thoroughly tested by the experiment stations or directly by the Department at certain selected points.

SUCCESSFUL RESULTS NOW DEMONSTRATED.

Macaroni wheats.—Up to the present time by far the greatest part of the introduction work with regard to cereals has been accomplished with the durum or macaroni wheats, and the macaroni-wheat industry may now be considered as thoroughly established. After thorough preliminary experiments had first been made, a considerable quantity of seed of several of the best varieties from eastern and southern Russia was distributed on rather a large scale. The results of this more general distribution were successful beyond the expectations of the Department.

The success of the work with this group of wheats and what it means to the country may be summarized as follows:

(1) The yield is, on an average, one-third to one-half more per acre than that of ordinary varieties on the same farm.

(2) It is demonstrated that these varieties will grow throughout a belt of the semiarid plains extending fully 100 miles each way from the one hundredth meridian as its median line, a belt within which the cultivation of grains has heretofore been at least a very uncertain industry and in a large portion of the region entirely impossible. A very large area of country is thus made available for profitable crop cultivation which was not heretofore considered to be of value except occasionally for stock ranges, which were fast losing their value even for grass production, and all this without the cost of irrigation.

(3) By bringing the farmers and the manufacturers in close relation with each other the Department has been able to establish a good price for these wheats, which have hitherto been considered by the millers of the country to be almost worthless for milling purposes.

(4) The amount of this wheat grown last season was not more than 75,000 bushels, and probably only two-thirds of that amount. This season, as announced elsewhere in this report, the crop bids fair to reach 1,500,000 bushels, an increase in production of twentyfold in one year.

(5) As an additional result of the establishment of these wheats, a half dozen or more new macaroni factories have been established in the last two years—one of these with a capital of $175,000.

(6) Both chemical and factory tests demonstrate the quality of this wheat, as grown in this country, to be quite equal to that of the same kind of wheat from any other part of the world.

(7) Heretofore an average of 15,000,000 pounds of foreign macaroni have been imported each year, costing the consumer nearly twice as much as the domestic product, and solely because the foreign macaroni, being made from durum wheat, is considered to be better than our own. We are now already producing two or three brands of macaroni from home-grown durum wheat, which is considered by experts to be entirely equal in quality to the foreign product.

(8) A number of millers who never before thought it could be done are now successfully grinding the durum wheat, and a considerable amount of bread of excellent quality is already being made from this wheat.

For other statements concerning these wheats, see the report of the cerealist of the office of Vegetable Pathological and Physiological Investigations.

Hardier winter wheats.—Where both winter and spring wheats are grown it is found that as a rule winter wheat produces on an average 5 to 10 bushels more per acre than spring wheat on the same farm. But as it is difficult and often impossible, on account of the severity of the winter, to grow winter wheats in the more northern portions of the country, it is the effort of the Department at present to introduce much hardier varieties of winter wheat. This work has already progressed beyond the preliminary stage of testing the varieties on a small scale. Several varieties from northern and eastern Russia are found to be considerably hardier than the Turkey—the hardiest of our winter wheats grown at present. During the coming year further experiments are to be made with these new varieties on a much larger scale. On the strength of preliminary experiments and suggestions

of the Department the millers of the West have already imported thousands of bushels of a hardy Crimean variety from Russia. Other varieties now under experiment are still more hardy.

Swedish Select oats.—The importation of this variety of oats from northern Russia in 1899 has, after three years' trial, resulted in almost completely revolutionizing oat cultivation in Montana. It has been impossible to supply the demand for seed of this variety in that State, although it has sold at a good price. In Wisconsin the success of this variety has been almost as great.

Tobolsk oats.—This variety, introduced at the same time as the Swedish Select, and though not so popular as the latter, has proved to be a valuable introduction and has given good results as far north as Alaska.

Emmer.—This cereal, erroneously called spelt, has been grown to a limited extent for a number of years in the Northwest. This Department, however, has succeeded in extending the area of its cultivation much farther, and other varieties have been introduced that were not grown before. It is an extremely drought-resistant grain, but also occasionally does well in humid regions. It is now known to be an important crop for stock food over a large portion of the semiarid plains.

Proso or broom-corn millet.—Five different varieties of this cereal were introduced from Russia in 1899, and two others since that time. The experiments made with them have been so far mainly in cooperation with the experiment stations, but in a number of places with private parties also. Very successful results, even better than were expected, have been obtained with these varieties, especially in South Dakota and California. Three varieties have proved to be particularly resistant to drought, providing food for stock over a large area where it is difficult to grow much stock food of any other kind. These three varieties are the Red Orenburg, Red Voronezh, and Black Voronezh. The Black Voronezh is the most resistant to drought, while the Red Voronezh is found to be the earliest maturing of all varieties, ripening in fifty days from the date of seeding.

Orenburg buckwheat.—This variety of buckwheat, obtained from east Russia on the Siberian border in 1899, has proved to be extremely well adapted to the regions far north. Among four or five varieties it was the only one able to mature a fair crop in Alaska.

Malakhov sugar corn.—This variety of sugar corn, obtained from north central Russia, after several years' trial, has proved to be an exceedingly early variety, and will mature ears in the extreme northern portions of the United States where other varieties entirely fail. It is not only earlier than other varieties but usually sweeter, and has been particularly valuable in South Dakota.

RICE GROWING.

To give the American rice grower the advantage of every improvement in methods or in varieties that might be found to be in use in other rice-producing countries, Dr. S. A. Knapp was authorized to visit Japan, China, India, and the Philippine Islands, and to report upon the agriculture of these countries, especially as it relates to the culture of rice, and to secure seed of promising varieties for test in

the United States. It is evident from Dr. Knapp's report that the price paid for labor in other rice-producing countries is so low that the American planter must rely on the use of the best methods and the best machinery in order to compete with the foreign producer. There is no doubt, however, that with the general use of the best varieties which the Department has imported and which we are now propagating, and with such improvements in machinery and methods as American ingenuity will be sure to suggest, rice culture will become one of the great industries of the South.

DATE INTRODUCTION.

The dates previously imported and planted in the semiarid Southwest are all growing well and give promise of the successful introduction of this fruit. A new shipment has been received during the past year, 224 young trees being sent from Persia by the Hon. Barbour Lathrop, to whose generous interest in the work of plant introduction the Department owes a great deal of the material it has been enabled to place before the American planter in the past. These dates are said to be superior to any that reach the American market from the East. The trees sent by Mr. Lathrop represent the best date varieties in the world, and are likely to ripen earlier than the North African varieties. The cooperative date orchard in Arizona now comprises 11 acres and contains 580 imported trees, besides 80 native seedlings. It is of interest to report that a number of the suckers imported in 1900 blossomed this year, and that there is a prospect that some fruit may be secured two years from planting.

EGYPTIAN CLOVER.

This variety of clover, known in Egypt as Berseem, is highly esteemed in the Nile Valley. It there serves the double purpose of a soil reclaimer and enricher and of a most excellent forage plant. The continued fertility of portions of the Nile Valley which are annually overflowed is probably as much due to the nitrogen-gathering properties of this plant as to the fertility of the Nile silt.

Seed of this clover has been brought to this country at different times, but owing to an imperfect understanding of the proper methods of handling this crop it has never been a success. During the past year, however, Mr. D. G. Fairchild, agricultural explorer of the Department, spent sufficient time in Egypt to study the methods of handling Berseem, and a bulletin on this subject has already appeared. Acting on this new information, a quantity of the seed of several varieties was imported and sent to such parts of the irrigated Southwest as seemed to offer favorable conditions for the growth and profitable culture of this clover. It is as yet too early to expect definite reports as to the outcome of the experiments, but there is reason to believe that Berseem will prove a valuable plant in some sections, such as the overflowed rice lands of Louisiana and Texas.

THE JORDAN ALMOND.

In the year 1900, about 5,500,000 pounds of almonds were grown in California, but many pounds were still imported from Spain, $683,000 worth in 1897, because the California nut was not equal to the best imported, known as the Jordan almond. This variety is found only in certain districts of Spain, and is highly prized by confectioners

because of its large size and desirable shape. During the past year scions and buds of this variety have been secured, and it is certain that in a few years California will produce all the almonds we shall use, and those of the best quality.

TURKESTAN ALFALFA.

In 1898, the Department made the first importation of Turkestan alfalfa seed. The seed secured at that time was obtained partly in the cotton districts of Turkestan and partly to the north of Tashkent in a mountainous country having a rigorous climate. The seed imported was distributed throughout the Northwest, and it was found that the seed grown in the colder climate of the mountainous country was especially adapted to our Northwest. The gratifying results obtained from this seed justify us in making another large importation of seed of this hardy variety for general distribution throughout the Northwest. This seed will be bought by a special agent of the Department, and it can be said with the greatest confidence that the seed secured will be the best that can be obtained.

ALKALI-RESISTANT ALFALFA.

The great need of a large section of the irrigable Southwest is to have varieties of plants that will thrive in soils having from 0.6 to 1 per cent of alkali. The most valuable plant for this region is alfalfa, but the variety at present grown will not thrive in soil containing more than 0.4 of 1 per cent of alkali. From the reports of our agricultural explorers and others familiar with the soil conditions in Algeria and in Egypt, there seems reason to believe that an alfalfa resistant to at least 1 per cent of alkali in the soil may be found in these countries. We have, therefore, sent two of the Department experts to Algeria and Egypt with instructions to study the agricultural conditions and to bring back seed of any varieties of alfalfa and of other useful plants with which to experiment in the alkali soils of the Southwest. These will be carefully tried, and if any prove useful the seed will be secured in sufficient quantity to make a general distribution in the alkali region.

PLANS FOR THE FUTURE.

With a view to systematizing the entire seed work, a reorganization has been effected whereby all matters pertaining to the securing and distribution of the seed for the Congressional distribution and the foreign introduction work have been placed in charge of Mr. A. J. Pieters. In view of the extent to which the work of distributing seed had developed in the Department when this Bureau took charge of it, an effort was made to bring about such changes as would improve the efficiency of the service in every way consistent with economy. It has long been conceded that the contract system of handling the main part of the work was open to serious objections. The contract, as a rule, is taken at a low figure, and it is necessary for the successful bidder to secure seed as cheaply as possible in order to realize a profit out of the work. The rules of the Department in regard to vitality, purity, and other tests protect its interests to a certain extent, but not fully, no matter how rigidly these rules may be enforced. As a first step, therefore, toward improvement, it was planned for the forthcoming distribution to abandon the contract system, except in so

far as it pertained to the work of packeting, assembling, and mailing the seed. To carry out this and other needed changes the following plan, approved by you, is in operation for the present year, and so far has proved very satisfactory:

(1) The Department secures its own seed and provides for the necessary packeting, shipping, etc., or the purely mechanical features of the work, by contract. This plan has made it practicable to secure from the most reliable sources such seeds as may be needed, and does away entirely with any opportunity or inducement for substitutions, reduced weights, or anything of this nature. To carry out the plan to the best advantage the country has been divided into districts according to climatic requirements, and certain assortments adapted to these districts will be distributed therein. Aside from the benefits derived from each district getting the things best suited to it, the plan does away with the necessity of having to secure such large quantities of a variety, thus enabling the Department to decrease the families and increase the number of varieties. It also adds materially to the elasticity of the entire work, making it feasible to consider the individual needs of different localities much more in detail than has been practicable in the past. For example, under the new plan it is practicable to furnish Members who have city constituents with flower seed only, if they so elect. It is also practicable to prepare assortments of both flower and vegetable seeds for special purposes, such as nature-study work in the public schools, the encouragement of agricultural studies in other schools, etc.

(2) The Congressional distribution proper is being confined as closely as possible to new, rare, and special seeds and plants, and the building up of agriculture and horticulture by demonstration experiments with the seeds and plants distributed. For convenience the work is divided into two classes, viz, (*a*) the distribution of special seeds and plants, such as forage crops, tobacco, cotton, sugar-beets, cereals, etc.; (*b*) the distribution of miscellaneous vegetable and flower seeds. In the handling of the special seeds and plants, due attention is being paid to the requirements of different sections of the country, and the crops are being so selected as to meet the needs and requirements of the districts into which seeds and plants are sent. A promising forage crop is distributed, for example, in a section where the nature of the soil and climate indicates success, and where the cooperation of a sufficient number of farmers can be obtained to make the work in a measure a demonstration experiment. The same plan is followed with tobacco, cotton, and other special crops, particular attention being given to comparatively new things.

(3) In the miscellaneous distribution of vegetable and flower seeds the work is being so conducted as to gradually introduce new or little-known things, dropping them after the first or second year, and leaving the demand created for them, if demand there be, to be supplied by the trade. Efforts are being made to cooperate with the seedsmen of the country in the matter of obtaining specialties and novelties, and disseminating these instead of the older sorts, taking care, of course, that nothing is sent out without some good claim to value and newness. To determine whether or not the seeds have value, plans have been perfected for cooperative tests with experiment stations. As soon as it is determined that a novelty or specialty is worthy of dissemination, arrangements will be entered into for the growing of a sufficient quantity of the seed for distribution, and it will be distrib-

uted under the name of the introducer in order to give proper credit, and in order to guarantee a protection to the Department.

As this work develops, it is hoped that it may more and more be made to serve the purpose for which it was originally intended, viz, the advancement of agriculture and horticulture in the country, without interfering with legitimate branches of trade.

A number of changes will be made in the general work pertaining to the foreign seed and plant introduction. The promiscuous introduction of small lots of miscellaneous plants will not be encouraged, as it is believed that work of this kind does not give results commensurate with the time and money expended in pushing it. The main object of this work is to build up new industries in the country, and for this reason the investigations often lead into broad questions on various commercial matters. The work, therefore, will be confined mainly to the introduction of such rare seeds and plants from abroad as give promise of adding to the wealth of the country and making possible the development of new lines of work. One of the serious drawbacks to this work in the past has been the inability to secure proper records of the distributions made. This was owing in large part to the fact that more things were introduced and disseminated than could be properly cared for, and, furthermore, the great difficulty in securing proper interest on the part of those to whom seeds and plants were sent in this promiscuous way.

With a view to further systematizing the work and making it practicable to keep in touch with seeds and plants introduced, it is believed that a system should be devised whereby representative agents of the Department in the State experiment stations or elsewhere will be kept in close touch with the work here, and will carry out, under the direction of the Department, systematic testing of such plants and seeds as may be forwarded from time to time. Such a plan will necessitate dividing the country into working divisions and securing the right kind of a man in each division to handle what may be sent him. In this way the Department will be able to fully control plants and seeds distributed, and by proper reimbursement of its agents can keep an interest in the work that can not be maintained in any other way. In the introduction of any plants or seeds it is essential and necessary first to determine where they are likely to prove most successful. After this is accomplished it is also necessary and essential to convince farmers or fruit growers of the feasibility of growing the particular crop. Even then the work is not finished, for although the crop may be grown readily, the question of a market must be considered. It follows, therefore, that general and promiscuous distribution is very wasteful, and that satisfactory results can probably be obtained much quicker and at less expense by putting into operation a plan as already described. This matter is now under careful consideration, and it is hoped that the plan may be put into full operation during the present year.

REPORT OF THE FORESTER.

U. S. Department of Agriculture,
Bureau of Forestry,
Washington, D. C., September 1, 1902.

Sir: I have the honor to transmit herewith a report of the work of the Bureau of Forestry for the fiscal year ended June 30, 1902, together with an outline of the plans for the work of the Bureau for the current fiscal year.

Respectfully, Gifford Pinchot,
Forester.

Hon. James Wilson, *Secretary.*

WORK OF THE YEAR.

Introduction.

During its first year as a Bureau, the former Division of Forestry has rapidly assumed the character and functions of its new position. With the increased capacity to do its work, the Bureau has gained in stability and effectiveness, and in the character and value of its results. While from the lack of American foresters it yet falls below a high standard of equipment in trained men, a larger proportion of educated foresters than ever before was engaged in its work, both in the office and in the field. The organization of work made possible by the change from a Division to a Bureau has been of capital value throughout the year.

The progress of public interest in forestry during the year far more than kept pace with the growth of the Bureau. The demands for advice and assistance increase from month to month, and continue to outstrip more and more the ability of the Bureau to meet them. The time for the general introduction of practical forestry in the United States is evidently at hand, provided only the necessary information and assistance can be supplied. The inability of the Bureau of Forestry to meet this demand because of inadequate resources is thus the most serious bar to the protection and perpetuation of our forests. With the rapid extension of professional education in forestry, the need of the Bureau for trained foresters can next year be met more nearly than ever before. In view of the increasingly rapid destruction of our forests, it is most fortunate that the imperative demand for assistance in checking the loss is paralleled by the opportunity to supply the demand, if only the necessary resources in money are made available.

Summary.

FOREST MANAGEMENT.

Private lands.—The demands for assistance in introducing practical forestry on private lands increased during the past year almost as much as during the three preceding years. These applications have now reached a total of 4,709,120 acres, under an arrangement by which the owners pay all expenses of the field work except the salaries of members of the Bureau.

The total area of private forests under conservative management, however, reached only the comparatively insignificant total of 372,463 acres, or 7.9 per cent of the total applications. The Bureau has thus been obliged, for lack of men and money, to neglect or defer over 90 per cent of its opportunities to introduce practical forestry on private lands.

It must not be forgotten that the overwhelming bulk of the forests in the United States are in private ownership, and that forest protection by the Government, while absolutely of vast importance, is relatively insignificant when compared with the action of the lumbermen and other private owners. In the light of these facts, the inability of the Bureau to respond to more than 8 per cent of the requests for advice in applying the principles which it continually advocates is seen to be the most dangerous of all checks on the progress of forestry.

Field work on seven large forest tracts was completed during the year, and preliminary examinations were made of 1,620,000 acres. The amount paid by the owners for the expense of working plans was $13,325.

Public lands.—The preparation of working plans for conservative lumbering on the public forest reserves, at the request of the Secretary of the Interior, has continued throughout the year. The total area of these reserves, September 1, 1902, is 58,850,925 acres. Field work was carried on during the past year in five reserves. In addition to field work and the computation of results in the office, the force of the Bureau was drawn upon to supply the entire lack of trained foresters in the management of the National forest reserves.

During the year a request was made by the Secretary of War for working plans for eight military wood and timber reservations, with a total area of 117,468 acres. Among these is the military reservation at West Point, upon which field work will be begun without delay.

Field work was completed on townships 5, 6, and 41 of the Adirondack Forest Reserve by the use of an appropriation of $3,500 made by the New York legislature to cover the field expenses of the Bureau of Forestry.

Forest measurements.—The force employed in computing field results was thoroughly organized. It completed during the year computations of 16,678 acres, and measurements of the rate of growth of 10,786 trees, of 25 species, in 13 States.

FOREST INVESTIGATION.

Commercial trees.—Measurements and sylvicultural facts were gathered for 20 species in various parts of the country. Studies of hardwood sprout lands were carried on in Massachusetts and other parts of New England, and promise valuable results. A special investiga-

tion of the Big Trees of California was begun and is still in progress, and a preliminary study of the swamp forests of eastern Missouri and Arkansas was undertaken.

Studies of North American forests.—The forests of Nebraska were made the subject of an elaborate report, and at the request of the Michigan forest commission an investigation of lands in the southern peninsula of Michigan was made, with special reference to the proper management of the Michigan Forest Reserve. Special studies of forest conditions were pushed forward in Kentucky, Ohio, and Texas, and of the distribution of forests in certain portions of New Mexico, Arizona, South Dakota, Wyoming, Montana, and California. In California the study of the relation of forest cover to the flow of streams was continued, and the results will shortly be ready for publication. In cooperation with the U. S. Geological Survey the study of the Sierra Forest Reserve was completed. In Vermont a cooperative study of the forest resources and conditions of the State was completed, and in Maryland the mapping of the forests by counties, begun in 1899, was continued. Attention was given, both in the office and in the field, to the region of the proposed Appalachian Forest Reserve.

Fires and grazing.—Investigations of the effect of grazing on the forest were conducted in Washington, Oregon, Wyoming, New Mexico, Utah, and California. The study of forest fires was conducted in 12 States, and work was pushed on the preparation of a report.

Dendro-chemical investigations.—Special attention has been given during the year to the chemical investigation of tan extracts from native woods and barks, and of gums from the Philippine Islands. The study of pulp woods, with special reference to the qualifications of untried species, has been carried forward.

Turpentine orcharding.—The investigation conducted by the Bureau into the methods of producing naval stores in the Southeastern United States has resulted in the development of a method which it is believed will radically affect the whole industry. A report is in preparation describing its actual operation.

Forest entomology.—In cooperation with the Division of Entomology, a beginning was made in the investigation of insect damage to the forest, with the direct purpose of devising remedies. The vast importance of the subject makes the continuance of this work imperative.

Various studies.—Investigations of the lumber industry of the State of New York and the maple sugar industry of the United States were completed, and a study of the osier willow industry was begun.

A careful investigation of the Eucalypts and Acacias cultivated in the United States was completed, and bulletins were prepared for each.

Timber construction and supplies.—In cooperation with the Bureau of Plant Industry, great progress was made during the year in arousing the interest of mining and railroad companies in the preservation of timbers and in the sources of timber supply. The practical assistance of many railroads toward the establishment of conservative forestry was begun, and the work shows conspicuous promise.

Forest exhibit.—A forest exhibit was prepared and installed at the Pan-American Exposition at Buffalo, and later transferred to Charleston, S. C.

TREE PLANTING.

Planting plans.—The cooperation of the Bureau of Forestry with the owners of timber land is paralleled by its cooperation with the owners of treeless areas who wish to plant. Up to June 30, 1902, there were received 262 applications for assistance, in response to 224 of which planting plans were prepared. In the course of the work 197,439 acres of land were examined. The area to be planted under plans already prepared is 6,474 acres. These plans cover 29 States and Territories and 172 different localities.

Planted woodlands.—In order to use the information already at hand from previous planting, careful studies of 20 large plantations, 8 in the Middle West and 12 in the East, were carried on during the year. A similar study is now under way to find trees adapted for the Southwestern plains.

Forest extension.—Studies of the natural extension of forests were continued during the year. A careful forest survey of a large part of Nebraska was completed, and resulted not only in arousing great interest throughout that State, but in the creation of two forest reserves for tree planting, a most valuable contribution to the forest policy of the United States.

Reserve planting.—Preparations for planting considerable areas in the two reserves in Nebraska were made during the latter part of the fiscal year.

Sand dunes.—Investigations with a view to preventing damage from drifting sand dunes were begun during the year, both on the Atlantic and Pacific coasts, and promise results of great value, especially along the Columbia River.

RECORDS.

Office work.—The office work of the Bureau has continued to increase steadily in efficiency throughout the year.

The collection of forest literature from the Department Library was transferred to the library of the Bureau, which now contains 1,120 bound volumes, 1,900 pamphlets, and numerous periodical publications.

The photographic collection was largely increased, and is now serving as the source from which nearly all forest illustrations are derived.

The correspondence of the Bureau increased until the number of mail pieces forwarded during the year was 24,538.

Eight new publications and 10 reprints were printed during the year, with a total number of 77,200 and 127,500 copies, respectively.

A photographic laboratory was prepared at the quarters of the Bureau, and was nearly ready for occupancy at the end of the fiscal year.

Forest Management.

PRIVATE LANDS.

During the past year the Bureau of Forestry has continued to give advice and practical assistance to private forest owners. The demands upon this branch of its work have increased steadily, and they are now even further beyond its capacity than at the end of the previous fiscal year. In the Southern States in particular there has been a

rapid awakening to the advantages of practical forestry, and a growing appreciation of the opportunity open to private forest owners through the offer of cooperation made by the Bureau in Circular No. 21, which gives the terms on which farmers, lumbermen, and others may cooperate with the Bureau in handling their forest lands. Wood lots, not exceeding 200 acres, are studied without cost to the owner, but in the preparation of detailed working plans for larger tracts the Bureau and the owner share the expenses of the work, the former paying the salaries of its men and the latter their traveling and field expenses. From July 1, 1901, to July 1 of the present year, 37 applications have been received from private owners for advice and assistance in the management of their forest lands. Twenty-five were for timber tracts and 12 for wood lots. They reach a total of 1,904,476 acres. The total area of private lands, in handling which assistance has been requested since the publication of Circular No. 21, in October, 1898, to July 1, 1902, is 4,709,124 acres.

WORKING PLANS MADE.

The field work necessary for detailed working plans was completed during the year for seven tracts with a total area of 421,000 acres in Maine, New York, Michigan, South Carolina, and Tennessee. The total amount estimated as the cost of these working plans to the owners was $9,725 and the total amount actually expended was $9,040.86.

One of these working plans was for a tract of 110,000 acres in Polk and Monroe counties, Tenn., on the western slope of the SmokyMountains. The field work occupied a party of 12 men for six months. It included a thorough study of the forest, the habits and rates of growth of the timber trees, and their behavior after lumbering. A careful investigation was made in order to determine what modifications of present methods of lumbering will leave the forest in good condition without seriously impairing present profits. The stand was actually measured upon 1,500 acres, and 1,200 measurements of volume and rate of growth were made upon felled trees. The tract was divided into blocks, according to watersheds, and the stand of each of the merchantable kinds was computed separately for each block. The silvicultural problem was very complicated because of the large number of species in the forest mixture. Only a few of these have as yet any market value, and it was difficult to determine how the tract may be lumbered so that the reproduction of the few valuable kinds may hold its own against that of the less valuable trees upon the lumbered areas. Careful studies were made of the habits of the more important trees and of the other local conditions which determine the form of management. Methods for the effective protection of the forest from fire were thoroughly investigated. The principal recommendations of the working plan may be summarized as follows:

(1) A diameter limit is set for each of the commercial trees, below which none may be cut.

(2) A certain number of trees above the diameter limit recommended should be marked and left standing to serve as seed trees.

(3) Contracts for the sale of stumpage should provide that a certain quantity of the less valuable kinds be cut and removed with the valuable trees. This should be done in order to leave the forest after lumbering in a condition favorable to the reproduction of the valuable kinds, the chief object of the working plan being to produce a future

stand of timber in which Yellow Poplar, Ash, Hickory, Walnut, and White Oak will be much better represented than in the present forest.

(4) A plan is outlined for the protection of the cut-over lands against fire.

The application of practical forestry to this tract is exceedingly important as a long step toward the adoption of conservative forest methods in the Southern Appalachians.

Another tract for which a detailed working plan was prepared lies in Scott, Campbell, and Anderson counties, Tenn., and has an area of 50,000 acres. The field work occupied a party of 10 men for four months. The tract is situated in the bituminous coal district of the Cumberland Mountains, and in addition to a valuable stand of hardwoods the property contains numerous accessible veins of soft coal, for which a good market exists. The object of the owners is to lumber conservatively in conjunction with mining operations. The main object to be worked for is to combine present profits with a valuable second crop. To this end the more valuable species will be favored in the lumbering and so given every chance to reproduce themselves well. The present forest is a mixture of hardwoods with a sprinkling of White, Shortleaf, and Scrub Pine, and Hemlock. It is remarkable for the number of species. Among the more important are Yellow Poplar, Ash, Hickory, White Oak, Chestnut Oak, Black Oak, Post Oak, Black Walnut, and Black Cherry. Most of the merchantable timber stands in the coves or hollows, while the slopes are covered by an open and less valuable growth. As a basis for an estimate of the stand of merchantable timber, all the trees were actually measured on 2.5 per cent of the total area. To ascertain the merchantable contents and the rate of growth of the commercial kinds, measurements called stem analyses were made of 2,474 felled trees. For greater accuracy, the tract was divided into 18 blocks, the boundaries of which correspond to the boundaries of the smaller watersheds, and the stand was calculated separately for each block. The working plan contains detailed silvicultural descriptions of the three principal types of forest growth—coveland, Chestnut Oak slope, and Black Oak slope. It also discusses the silvicultural characteristics of the most important species, and gives diagrams showing their rate of growth in diameter, height, and merchantable contents. The regulations for lumbering give the diameters for each species, under which no tree should be cut, and direct that certain trees of the more valuable species above this diameter limit be marked and left standing to furnish seed for a second crop after lumbering. A plan is outlined for the protection of cut-over lands from fire, and recommendations are made concerning transportation and contracts for the sale of stumpage. The working plan is accompanied by a forest map, showing the distribution of the important timber trees. The conditions on this tract are peculiarly favorable to the successful application of practical forestry.

A tract of 60,000 acres for which the field work was completed is that of the Okeetee Club, in Beaufort and Hampton counties, S. C. The important tree here is the Longleaf Pine. As a result of the past management, the forest varies irregularly from mature stands to young woods, and is broken by occasional patches of open ground, where heavy cutting followed by fire has destroyed the forest altogether. The hearty cooperation of the Okeetee Club in the scientific investigations of the Bureau of Forestry and the exceptional oppor-

tunity for experimentation which is offered combine to give this piece of work peculiar usefulness.

The working plan deals mainly with the following points:

(1) An accurate estimate of the stand of merchantable timber.

(2) A study of the rate of growth of the Longleaf Pine.

(3) A system of fire protection and the organization and instruction of a fire service.

(4) A plan to foster and increase the reproduction of the Longleaf Pine.

(5) Where lumbering operations should begin, how they should be carried on, to what extent the timber should be cut, what yield should be expected, what would be the expense of cutting and marketing under proper rules, and what financial results might be expected.

The preparation of the working plan for a tract of 10,000 acres on Grand Island, Michigan, gave useful results. The field work necessary for a working plan occupied a party of 6 men for two months. The stand was actually measured upon 301 acres, and 299 measurements of contents and rate of growth were made upon felled trees in addition to careful silvicultural studies of the more important species. The forest is composed of hardwoods of large size, which, from the nearness of a strong market, are of high value. There is here an unusually good opportunity for conservative forest management, upon a paying basis from the start.

The tract of the Moose River Lumber Company, of 15,000 acres in Herkimer County, N. Y., was studied by a party of 4 men for four months, and the data necessary for a working plan were collected. The area is equally divided between virgin and cut-over land. On the latter there is a fair amount of small spruce among the first growth of hardwoods, while the former contains in addition a fine stand of mature spruce. The Moose River Lumber Company operates its own mill at McKeever, and can therefore manufacture its own product without the expense of long transportation for its logs. The unusually good opportunity for conservative forest management rendered the preparation of a working plan for this tract of decided importance.

The sixth tract upon which the Bureau completed field work during the past fiscal year includes 150,000 acres of the 275,000 acres in northwestern Maine which belong to the Great Northern Paper Company. The field work occupied a party of 20 men for four months. It included complete measurements of the stand upon 3,303 acres, and of the volume and rate of growth upon 900 felled trees. Careful study was made of the Red Spruce and Balsam, which are here, both commercially and in number of individuals, the most important trees. The chief problem in the management is so to modify the present methods of lumbering that the Spruce may hold its own in the reproduction on cut-over areas. A part of the field work was the preparation of a map of the tract to show the topography and the burnt-over lands, the lumbered areas, the virgin forest, and the forest types.

The field work necessary to a working plan for the 15,000-acre tract of Mr. E. H. Harriman, near Arden, N. Y., was begun April 1 and completed June 15. It was carried out entirely by 9 students, constituting the senior class of the Yale Forest School, under the immediate direction of Prof. Henry S. Graves, formerly assistant chief of the Division of Forestry, and still a collaborator of the Bureau. A forest map of the entire tract was made, as well as a careful study of the forest, by which its character, condition, present stand, and future yield were ascertained.

The working plan will deal with the following topics:

Part I:
- The purpose and scope of the examination.
- Character of the forest, including a general description of the distribution of trees, distribution of age classes, merchantable yield, present condition of the timber, future production, etc.
- Recommended treatment of the forest, including a description of the thinnings actually made.
- Financial possibilities of the forest.

Part II:
- Detailed description of the forest by compartments.
- Forest map.
- Silvicultural study of the forest.

During the spring about 100 acres were thinned under supervision, and about 1,000 cords of wood were cut.

WORKING PLANS IN PREPARATION.

Personal examinations were made during the year of 10 timber tracts in the States of Georgia, Tennessee, North Carolina, South Carolina, Texas, Pennsylvania, and New York, covering a total area of 1,620,600 acres. The preparation of detailed working plans was recommended for six of the timber tracts examined and the recommendation in each case was approved by the owners, at a total estimated cost to them of $10,100.

The largest and most important of these tracts is that of the Kirby Lumber Company and the Houston Oil Company, in southeastern Texas. It comprises an area of 1,250,000 acres, and includes practically all of the virgin Longleaf Pine land in the 7 counties in which it is situated. The forest is divided into three principal types: Longleaf Pine land, Shortleaf Pine land, and hardwood bottom land. The first covers about 80 per cent of the total area and is commercially the most important.

The opportunity for practical forestry on these lands is unusually good. The tract consists largely of pure woods of Longleaf Pine, only about 15 per cent of which have been cut over. With reasonable protection the reproduction is assured, while the presence of a heavy stand of mature timber, the absence of underbrush, and the flatness of the country are conditions exceedingly favorable to clean, conservative lumbering.

The points which will be chiefly studied in the preparation of the working plan are the following:

(1) The present method of lumbering and its effect upon the forest, in order to ascertain what practicable modifications will hasten the production and improve the quality of a second crop.

(2) The reproduction of the Longleaf Pine and the rate at which it produces timber.

(3) The effect of fire on the Longleaf Pine, and the fire problem in general, in order to devise a simple and effective system of protection. Whether this system should include the whole area of the forest or should, as seems probable, deal only with the protection of lumbered areas until the reproduction is old enough to be comparatively safe, can be decided only by a thorough study on the ground.

(4) The railroad tie industry, its effect upon the forest, and its commercial wisdom under the methods and to the diameter to which trees are now cut for ties.

Another valuable opportunity for practical forestry is offered by a

tract of 72,000 acres, the property of E. P. Burton & Co., situated in Berkeley County, S. C. The principal species are Loblolly and Longleaf Pine. Ease of lumbering and transportation and excellent reproduction render this tract one of the most promising with which the Bureau has yet had to deal.

A third tract for which an examination was made, a working plan advised, and its preparation approved by the owners, is that of the Linville Improvement Company, in Mitchell, Caldwell, and Watauga counties, N. C. It has an area of 16,000 acres. The forest is composed chiefly of broadleaf species, among which Yellow Poplar, Yellow Birch, and the oaks are the most important. It presents an interesting silvicultural problem in addition to conditions exceedingly favorable to conservative management upon a sound financial basis.

A smaller but not less promising tract which has been examined, and for which a working plan is now being made, lies on the west side of the Susquehanna River, 13 miles above Harrisburg, Pa., and has an area of 2,300 acres. The owner wishes to hold it as a permanent investment and to manage it with this end in view. With the exception of about 200 acres the forest is composed entirely of sprout growth of Chestnut, Rock Oak, White Oak, and Hickory, together with excellent Scrub, White, Shortleaf, and Jack Pine. A strong market exists for all kinds of forest produce, and transportation facilities are good.

PUBLIC LANDS.

The preparation of working plans for the National forest reserves is one of the urgent pieces of work before the Bureau. It has arisen from the request upon the Secretary of Agriculture from the Secretary of the Interior for advice as to the best management of the reserves, which now comprise a total area of 58,850,925 acres. The study on the ground necessary to a working plan was carried on during the past year in the Prescott Forest Reserve, Arizona, which contains 423,680 acres, the Priest River Forest Reserve, in Idaho, with an area of 645,120 acres, and the Big Horn Forest Reserve, in Montana, which includes 1,216,960 acres. The field work in the Prescott Reserve occupied a party of 11 men for three months. Measurements of the stand were taken upon 1,648 acres, and 1,840 measurements were made of volume and rate of growth; the Bull Pine was carefully studied, particularly with reference to the effect of the present methods of lumbering upon the reproduction of the tree, and the data were obtained for a comprehensive plan for the best management of the reserve with due regard to its value in the production of timber and in maintaining the water supply. The field work carried on in the Big Horn Reserve occupied a party of 7 men a period of four months. The stand was measured on 820 acres, and 1,299 measurements made upon felled trees. In the Priest River Reserve a party of 6 men were at work for three months. The stand was measured upon 879 acres, and 720 measurements of volume and rate of growth were made.

A thorough preliminary examination preparatory to a working plan is now being made of the San Francisco Mountains Forest Reserve, in Arizona.

The field work necessary to a working plan for townships 5, 6, and 41, Hamilton County, N. Y., in the Adirondack Forest Reserve, was begun and completed during the past fiscal year. It became possible through an appropriation of $3,500 by the New York legislature to

cover the field expenses of the agents of the Bureau engaged in the work. The area of these three townships is 69,916 acres, and the necessary studies on the ground occupied a party of 16 men for four months. The work was carried on upon lines similar to those followed in the preparation of a working plan for township 40, Hamilton County, which has already appeared as Bulletin No. 30, Division of Forestry. Measurements of the total stand were made upon 3,471 acres and of volume and rate of growth upon 2,081 felled trees. A careful study was made of the forest, not only from the point of view of the forester, but also from that of the lumberman, and a map was prepared for the three townships showing the combined work of both. This map, in addition to the forest types, gives information necessary to the best lumbering of the tract, showing desirable sites for splash dams, and indicating necessary improvements of streams for driving and other points of practical value to the lumberman.

MILITARY RESERVATIONS.

An important piece of work which will be taken up as rapidly as the force and appropriation of the Bureau will permit has arisen through the request by the Secretary of War upon the Secretary of Agriculture for technical advice governing the handling of military wood and timber reservations. These are eight in number and comprise a total area of 117,468 acres.

A preliminary examination has already been made of the West Point Military Academy Reservation of 2,000 acres stocked with second-growth hardwoods, and a detailed working plan has been recommended and field work will soon begin. An excellent opportunity is offered for thinnings which will materially improve the character of the forest and at the same time yield a supply of firewood for the use of the Academy.

FORESTS UNDER MANAGEMENT.

The working plan prepared in 1901 for the tract of the Sawyer & Austin Lumber Company, of Pine Bluff, Ark., and which has been published as Bulletin No. 32 of the Bureau of Forestry, was put into effect in March, 1902. The forest is a mixture of Shortleaf and Loblolly Pine, with scattered hardwoods, the pine only being cut to a diameter of 14 inches on the stump. The tract was visited by agents of the Bureau and the area to be cut over within the next year, approximately 6,400 acres, was carefully examined. On this area a certain number of Loblolly and Shortleaf pines to be left as seed trees were marked and stamped. They average one tree to 6 acres. It is estimated that there will be left after lumbering at least six seed trees below a diameter of 14 inches, and it is believed that with the larger trees referred to above they will amply suffice to seed up the cut-over lands. The Loblolly grows more rapidly than the Shortleaf and is of practically the same value in the market; hence, wherever possible, it was favored in the markings in order to increase the stand of Loblolly in the second crop. A good beginning in fire protection has been made. One thousand acres have been set aside and an attempt will be made to protect this area thoroughly against fire. It is favorably situated, being completely surrounded by abandoned railroad spurs. These spurs have been cleared of rubbish and will act as excellent fire lines. A man who lives on this area has been detailed

to act as fire warden, under a contract which provides that he shall be paid only in case there is no fire, or, if a fire occurs, then if he can clear himself of contributory neglect; that he may hire assistants when necessary, that he must burn a fire line round the area once or, if necessary, twice a year, and that he shall keep the land thoroughly posted.

An experiment was made on this tract in burning the tops of felled trees, which are sources of great danger if fire once starts on cut-over land. It was found that to be burned successfully the tops must first be lopped and piled. If this method does not prove too expensive upon further trial, the tops on all cut-over lands will be dealt with in this way. An examination was made of the height at which stumps are now cut, and a report was submitted to the company showing the loss which follows from cutting high stumps.

In 1898 a working plan was made for the several wood lots included in the estate of Maj. W. A. Wadsworth, near Geneseo, N. Y. The owner desiring to put the plan in operation, the lands were visited by an agent of the Bureau of Forestry in the fall of 1901. The forest is composed of a mixture of hardwoods, and the main object is so to lumber it that its future productiveness will be assured. All trees to be cut were marked and stamped. The markings favored the more valuable Hickory, Ash, Black Walnut, and White Oak against the less valuable Beech, Maple, and Black Oak. The intention was both to aid the former in the present stand and to increase their relative proportion in the second growth which will follow the lumbering. All dead or dying trees were at the same time marked for removal. An excellent local market exists for lumber, cord wood, and ties. There is assurance that the cutting will prove a financial success and will tend to improve the forest.

The work in practical forestry on the 6,000-acre domain of the University of the South, at Sewanee, Tenn., goes steadily on. Trees containing approximately a total of 500,000 feet board measure have been marked for felling by the Bureau of Forestry, and the lumbering proceeds under its general supervision.

In the Adirondacks the tract of the Moose River Lumber Company has been added to those to which practical forestry is applied under the direction of the Bureau. In accordance with the recommendations of the working plan Spruce is being lumbered to a diameter of 12 inches. The marking of the trees to be cut, as well as the lumbering itself, is being carried on under the general supervision of the Bureau. An experiment is also being made in the conservative lumbering of the hardwoods.

The working plan for the tract of 110,000 acres upon the west slope of the Smoky Mountains in eastern Tennessee has been applied and lumbering has begun under the supervision of the Bureau. Contracts made for the sale of stumpage include provisions recommended by the Bureau. These specify the kinds which shall be lumbered and fix the diameter limits to which they shall be cut. They provide against waste in lumbering and against unnecessary damage to young growth. It is further provided that trees cut in violation of the rules for conservative lumbering drawn up by the Bureau of Forestry shall be paid for at double the contract price.

Including lands not mentioned above, the total area of private forests actually under the supervision of the Bureau of Forestry is 372,463 acres.

FOREST MEASUREMENTS.

The force employed in computing field data was thoroughly organized as a section of the division of forest management during the past fiscal year and the effectiveness of its work notably increased thereby. This section now is equipped to handle all the figures of any kind gathered by the Bureau in its many lines of activity.

During the year the section of forest measurements worked up the figures and prepared the tables for the working plans made by the division of forest management and for the studies of commercial trees by the division of forest investigation. The data consisted of measurements obtained in 13 States and upon 25 species. It included surveys of the stand of timber upon 16,678 acres and analyses of 10,786 trees. These were cast into final tables of present and future stands and yields, of volume, and of rates of growth in diameter and height for the localities and species covered. With the exception of data obtained in the Black Hills Forest Reserve, which await further figures before they can be completed, the force engaged upon forest measurements has entirely finished the work for the field season of 1901, and has scaled also 10,000 acres of surveys left over from 1900.

EXPENDITURES.

The total expenditures during the year by the division of forest management were $53,947.89, or 29.1 per cent of the total appropriation of the Bureau.

Of the $13,325 contributed by owners as their share of the expenses in the preparation of working plans, begun or continued during the year 1901–2, $9,160 had been expended at the end of the fiscal year.

WORK FOR THE ENSUING YEAR.

WORKING PLANS.

Public lands.—The field work necessary to a working plan for the San Francisco Mountains Forest Reserve will be undertaken, since the preliminary examination has established its advisability. Working plans will probably be begun for three other forest reserves, the preliminary examinations of which will be made during the current year.

Private lands.—The study of private forest lands, in the handling of which assistance has been requested under the terms of Circular No. 21, will be carried on as rapidly as the appropriation and the field force of the Bureau will allow. Particular attention will be given to the rendering of assistance in the handling of wood lots. The field work necessary to a working plan for the 1,250,000-acre tract of the Kirby Lumber Company in southeastern Texas will be undertaken, and also for the two tracts of the E. P. Burton Lumber Company, the one of 45,000 acres, the other of 6,000 acres, in South Carolina.

INSPECTION.

Forests under management.—Markings and inspection of lumbering will continue upon those forest lands already under the general management of the Bureau, and upon other lands for which their recommendation is approved in working plans already prepared or in process of preparation.

FOREST MEASUREMENTS.

The section of forest measurements will continue to work up all field results obtained by the Bureau. It will at the same time carry on field work within its own province.

COMMERCIAL TREES.

The purpose of the Bureau in this branch of its work is to complete during the ensuing year the studies of commercial trees already begun. The more important of these are the southern hardwoods, the southern pines, the Adirondack hardwoods, the Balsam in Maine and New York, the White Pine in Michigan, the Lodgepole Pine in the Middle West, and the Sugar Pine in California.

FOREST INVESTIGATION.

STUDIES OF COMMERCIAL TREES.

During the past year, both by this division and by the division of forest management, much valuable information was gathered for the discussion of the growth and yield of White Pine, Red Pine, White Oak, Scarlet Oak, Red Oak, and Aspen in Michigan; Sugar Pine in California; Balsam in Maine; and White Oak and Chestnut Oak in Tennessee, Kentucky, and Missouri. Similar data was collected for Lodgepole Pine in Wyoming and Montana, and for Western Yellow Pine in Arizona.

NEW ENGLAND HARDWOODS.

The study of New England second-growth hardwoods was continued by two field parties, and valuable facts were collected for the future discussion of their value and the best method of maintaining it.

The first draft of a study of the silvicultural characteristics of the Longleaf Pine was revised and enlarged. The study of the growth and characteristics of Loblolly Pine was not completed last year, partly on account of the illness of the expert in charge of the work and partly because his services were diverted to other urgent work. The report on this pine is now practically completed and the manuscript will soon be ready for the press. The study of the Sierra Big Tree in California and its exact distribution required additional attention, but is now practically finished. The maps and manuscripts will be ready for printing early during the present fiscal year. A study of the Bristle-cone Fir in southern California was completed and will shortly be ready for publication. The report on the Pacific Coast Redwood was prepared this year and awaits editorial revision. The report on Western Hemlock was completed and is in press.

SWAMP FORESTS.

A preliminary study of the factors which determine the distribution and best growth of swamp forests in eastern Missouri and Arkansas was begun last season. The timber trees concerned in this investigation are principally Cypress, Red Gum, and Black Gum. Little is known of the conditions most favorable to the reproduction and to the best growth of the Cypress, which is a timber of the first commercial value, or of the gums to be included in this study, the results of which are likely to be of practical value.

STUDIES OF NORTH AMERICAN FORESTS.

Michigan.—At the request of the Michigan forest commission a study was made of typical areas of forest and other lands in the

northern part of the southern peninsula of Michigan. The land examined is included in the State forest reserve, which contains some 60,000 acres of White, Red, and Jack Pine stump land.

A study of the reserve was made for the purpose of suggesting a plan for its proper management and for that of other similar lands in the same region, and recommendations were made to the commission.

Kentucky.—Investigations were begun last season on the forest conditions and resources of Kentucky, with special regard to the effects of destructive lumbering and of fire on the forest and its reproduction. A preliminary report of progress has been made, but another season's field work is required before a full report can follow.

Ohio.—A general examination of the forest resources of Ohio was begun last year to determine the location and extent of available supplies of commercial hardwood timber. In connection with this examination a study was begun of the relation of the wood-consuming industries of the State to existing supplies of timber. Search was made also for historical and other evidence to show the effect of denuding forest lands on the flow of streams. A report on the available tree species of the State has been submitted, together with a preliminary account of the consumption and principal sources of timber supply. The information in question is greatly needed to answer constant inquiries concerning supplies of Oak, Hickory, and other hardwoods.

A special study was begun of the moisture content of green wood. Tables have been constructed showing the percentage of water contained in samples of the green wood of seven commercial timbers of Ohio. This study will be extended and will form a basis for the determination of the best conditions for air-drying timber.

Texas.—The forest resources and general forest conditions of Texas were studied and a report which gives an accurate survey of the general and typical forest conditions of the State is nearly ready for publication.

New Mexico.—An examination was made of the forests on and in the region of the Sacramento Mountains. Particular attention was given to the relation of grazing to the perpetuation of the forest cover, and of the latter to the flow of water, which is of vital importance in contiguous agricultural regions.

Arizona.—Studies were made of the forests of Mount Graham, the Santa Catalina Mountains, the Huachucas, and the Chiricahuas. A portion of the forest lands of the Verde River basin was also examined, likewise with special regard to their relation to local water supplies. Aside from this question, the facts gathered will be of great service in answering frequent inquiries concerning the commercial timber supplies of these regions.

South Dakota —The forest lands on and in the vicinity of Turtle Mountain, Short Pine Hills, and Slim Buttes were studied and reported upon for the same important purposes.

Wyoming.—An examination of the forest lands contiguous to the Yellowstone National Park was made with special reference to the grazing problem. The urgent need for protection of the local water and timber supply gave this work peculiar significance.

Montana.—A special study was begun in the Flathead Lake region of the terrestrial and climatic factors which influence the distribution

of certain types of coniferous forests. The practical object of this study is an accurate knowledge of the soil, climate, and other conditions most favorable to the development of the species considered. A preliminary report of the progress of this work has been submitted. Further field investigations are needed, however, before a full report can be made.

California.—The study of the relation of forest cover to the flow of streams, begun two years ago in southern California, was continued. The facts collected during two field seasons, have been partly elaborated, but require further study, which is being given. It is believed that a complete report of this investigation will be ready for publication early in the present fiscal year.

A general study was made of forest land in northern California with a view to its protection against fire, overcutting, and overgrazing. The examination covered altogether more than 2,000,000 acres.

Iowa.—Studies of the distribution, character, and value of forests in Iowa have been in progress for some time. It is expected that complete reports will be ready for publication at the close of the calendar year. The information will be of particular value to land owners of the Middle West.

COOPERATIVE INVESTIGATIONS.

California.—The study of forests in the Sierra Forest Reserve was again taken up in cooperation with the U. S. Geological Survey, and the unfinished south half of the reserve was completed. The purpose of this work was to make a description and classification of the forest and other lands within the reserve, to map the distribution of tree species and forest types, and to ascertain the condition, quality, and stand of commercial timber. The relation of these forests to various industries was considered, and the effects of forest fires on the growth and reproduction of the trees. An area of about 3,000,000 acres was examined. A report of the work of two field seasons, covering the entire Sierra Forest Reserve, is in preparation and will be completed early in the present fiscal year.

Vermont.—In cooperation with ex-Governor Smith, the Bureau began a general study of the forest resources and conditions of Vermont with a view to recommending a forest policy. A preliminary report was submitted and the complete report is in preparation.

Maryland.—The study of the forests of the best timbered counties of Maryland, begun in 1899 in cooperation with the State geological survey, was continued during last season under the same auspices. Reports on the timber resources and forest conditions of Cecil, Garrett, and Calvert counties have been prepared. Those on Cecil and Garrett counties are being published as a part of the report of the State geologist, while the Calvert County report will be published later.

Appalachian forests.—Descriptions of additional forest lands under consideration for inclusion in the proposed Appalachian Forest Reserve were completed during the past year. The results of this and the previous season's work, conducted in cooperation with the U. S. Geological Survey, were embodied in an elaborate report submitted to Congress and ordered published as Senate Document No. 84. The report is copiously illustrated by maps and photographs.

Its immediate purpose is to give reliable information upon the desirability and feasibility of establishing the Appalachian Forest Reserve. Aside from this purpose, the report embodies exhaustive data on the composition, condition, character, extent, and distribution of the forests of a little-known region.

EFFECTS OF GRAZING ON THE FOREST.

Investigations of the effects of grazing on the forest were conducted in the region included by the Yellowstone and present Teton forest reserves in Wyoming, in the Sacramento Mountains of New Mexico, in the Uintah Mountains of Utah, in the southern Sierras, and in the State of Washington. The purpose of these studies was to secure information which would permit a satisfactory regulation of grazing in regions where agricultural and other interests dependent upon water supply and upon timber have suffered as a result of excessive grazing.

STUDY OF FOREST FIRES.

A study of the effect of fires on the forest was conducted in Maine, Vermont, Michigan, Maryland, the Appalachian Mountains, Wyoming, Utah, Idaho, California, New Mexico, and Arizona. The examination of published forest-fire records was extended to a large number of Western papers. A discussion of the destruction caused by forest fires and the significance of the fire records now accumulated was embodied in a report which will be ready for publication during the present fiscal year.

DENDRO-CHEMICAL INVESTIGATIONS.

Under cooperative plans arranged last year between the Bureau of Forestry and the Bureau of Chemistry, the following dendro-chemical studies were carried on:

Commercial derivatives from native and exotic barks, woods, and gums.—Particular attention was directed to the quality and quantity of tan extracts produced by native woods and barks. The species studied include White Oaks, Black Oaks, Chestnuts, and Hemlocks. A number of gums produced in quantities by trees native of the Philippine Islands were studied with reference to the production of dammar and gutta-percha, and a large amount of work is yet to be done on similar material from the same source.

Standard pulp woods and untried species probably suitable for paper pulp.—The rapid exhaustion of the supply of standard pulp woods renders it imperative to discover, if possible, other equally useful species. To demonstrate the usefulness for pulp of certain plentiful timbers not yet used for that purpose will be exceedingly valuable if it can be done. Wherever supplies of such timber are present the life of the wood-pulp paper industry may be greatly extended.

The species being studied are White Spruce, Black Spruce, Red Spruce, Balsam Fir, Red Pine, White Pine, Loblolly Pine, Hemlock, Arborvitæ, Southern White Cedar, Aspen, Large-tooth Aspen, Cottonwood, White Birch, Basswood, Red Maple, Silver Maple, Tulip-tree, and Black Gum.

The study of these woods embraces the preparation of pulp from their woods and the manufacture of commercial paper in accordance

with standard methods of manufacture. A detailed microscopic study is also being made of the wood fibers as an additional means of ascertaining the structural basis of the excellence or unfitness of certain fibers for the manufacture of paper. The paper produced will be subject to thorough tests, including the wear and strains to which they are subjected in actual use.

Removal of resin from fir pulp woods.—In connection with the general investigation of pulp woods a special attempt is being made to devise a cheap treatment which shall remove all the resin in fir woods, or at least a sufficient part of it, to permit its reduction to pulp by grinding without clogging the reducing stones.

TURPENTINE ORCHARDING.

The method of producing naval stores in the South is rapidly destroying the forests of the Longleaf Pine, a timber whose preservation is absolutely essential to the prosperity of that region. These facts led to an investigation of the production of crude resin by the Longleaf Pine, and an attempt to devise a more economical system. The survival of the naval stores industry depends absolutely on the abandonment of the old system of boxing and the introduction of a new method which will protect the life of the tree. The old system invites the destruction of the forest by fire and wind, as well as by the boxing itself. The Herty method of tapping, devised by Dr. C. H. Herty, a member of this Bureau, leaves the tree practically intact. By this method the resin, from two or more shallow streaks chipped on the trunk, flows into galvanized iron gutters which conduct it to an earthen pot hanging by a nail to the trunk of the tree. To test the new method in comparison with the old, 20,000 trees in strips intimately mingled were tapped. Great care was taken to make the comparison perfectly fair. The run of gum from sets of trees tapped for the first, second, third, and fourth times was collected and measured for each method. A bulletin giving in detail the results of the test is now in preparation. It is sufficient to say here that in quantity, quality, and economy of production the new method is decidedly superior to the old.

The acknowledgments of the Bureau are due to Mr. John H. Powell, of Ocilla, Ga., without whose assistance this experiment could not have been carried out.

COOPERATION WITH THE DIVISION OF ENTOMOLOGY.

In cooperation with the Division of Entomology, much attention has been given during the past year to the ravages of insects injurious to forests. Problems of the first importance to conservative forestry are presented by insect damage in the East and West alike. It may be cited as an example that the timber killed by insects in recent years in the Black Hills of South Dakota amounts to not less than 600,000,000 feet B.M.

VARIOUS STUDIES.

A history of the lumber industry in the State of New York.—This study, prepared by the superintendent of forests of the State of New York, was completed during the year, and has recently appeared as Bulletin No. 34 of this Bureau.

Osier willow industry in the United States.—An exhaustive study was made of the status of the osier willow industry in this country. Important statistical data, hitherto unpublished, were compiled and supplemented by original inquiries. A representative of the Bureau studied on the ground the growth and management of American osier plantations, and added a thorough survey of the osier willow culture in foreign countries. A bulletin embodying the results of these investigations is nearly ready for publication. There is a widespread call for the information it will contain.

Tree growth on burned lands.—The study of burned mountain slopes in southern California was continued during the year. Special attention was given to the study of natural reseeding from surviving trees, and to experiments in direct seed planting of Western Yellow Pine, Torrey Pine, and Monterey Pine, in denuded sections. Since the spring rains very encouraging results have followed this seeding. With the exception of the Yellow Pine, the species named are of little direct value, but a protective cover of these trees will make possible the later introduction of more useful timbers. Strong local sentiment was aroused by this work, and the agent in charge has been given cordial support and assistance from settlers in collecting seed and in planting it.

Eucalypts cultivated in the United States.—A careful study was made of the distinguishing characteristics, culture, uses, and distribution in the United States of about 40 species of Australian Eucalypts, and the results of these studies were embodied in a bulletin which is now in press. Collectively, the information made available in this bulletin is nowhere else accessible. It will give information much needed and often requested by correspondents of this Bureau.

Acacias cultivated and naturalized in the United States.—A similar study was made of the Acacias cultivated and naturalized in the United States, but the report is not yet ready for publication. Information concerning these trees is in constant demand by correspondents of the Bureau in the Southwest.

TIMBER CONSTRUCTION AND SUPPLIES.

Durability of treated and untreated railway timber.—In cooperation with the Bureau of Plant Industry, the durability of timber used for construction, and particularly of railroad timber, was given thorough attention. Large quantities of railroad ties, contributed and transported without cost to the Department by various companies, were laid in the roadbed under test conditions.

The value of insect-killed timber, both treated and untreated, for various purposes was carefully investigated, and great interest in various questions was aroused among the mining and railroad companies. Widespread support and encouragement was given by the latter in various ways. This work, continued from previous years, is among the most promising in which the Bureau of Forestry has been engaged.

EXPOSITIONS.

The forest exhibit installed at the Pan-American Exposition on June 20, 1901, remained on exhibition until November 1, 1901, when, with the exception of the two largest transparencies, it was moved to Charleston, S. C., and installed there on December 30, in the South

Carolina Interstate and West Indian Exposition. The only new feature of the exhibit at Charleston was the addition of 70 samples of commercial woods from the Philippine Islands. At the close of the Charleston Exposition one-half of the exhibit was installed at the New England Association of Arts and Crafts, at Providence, R. I., where it now is; the remainder of the exhibit was boxed and shipped to Washington, D. C.

IDENTIFICATION OF FOREST SPECIMENS.

Much time was consumed in the division of forest investigation in identifying specimens of native and exotic trees and samples of commercial woods. An important service was rendered to the Tennessee and Virginia Boundary Commission by the identification of the species of witness trees and the determination of the ages of blaze marks upon them.

EXPENDITURES.

The total expenditures of the division of forest investigation during the fiscal year were $55,468.84, or 29.9 per cent of the total appropriation of the Bureau.

WORK FOR THE ENSUING YEAR.

DENDROLOGY.

Monographic studies of the White and Black Oaks and the osier willows will be continued, and studies will be begun of the Sugar Maple and the Western Cottonwood. Investigations of the forest floras of important regions will continue.

FOREST DISTRIBUTION.

A study of the character, extent, and value of forests in the best-timbered counties of Maryland will be continued in cooperation with the Maryland State geological survey. Studies of forest conditions and forest resources will be carried on in Vermont, Michigan, Ohio, Kentucky, Iowa, Montana, and California. Special forest problems concerning types of forests in Texas, Arkansas, and Missouri will also be taken up.

STUDY OF FOREST PRODUCTS.

Dendro-chemical investigations.—Chemical investigations of woods, barks, and gums to determine their production of tan extracts and of the adaptation of untried pulp woods for the manufacture of paper pulp will be continued in cooperation with the Bureau of Chemistry. The lines of this work will be considerably broadened to include examinations of new material and the manufacture and testing of papers made from untried woods.

Removal of resin from pulp woods.—In connection with the investigation of pulp woods, experiments will be continued to devise a method of cheaply removing resin from fir woods in order to facilitate their reduction by grinding to pulp. Similar experiments will be made also with inferior pine woods, which, if freed from resin, can be used for certain grades of paper.

MECHANICAL AND OTHER PROPERTIES OF LEATHER PREPARED BY TAN EXTRACTS FROM DIFFERENT NATIVE TANBARKS.

An investigation to determine the mechanical properties of leather from different tannages will be begun at the request of a leading manufacturer of American leathers, upon samples to be furnished by him and other manufacturers. This study follows naturally upon the investigation of tan barks already mentioned. It is expected to yield important results upon the comparative wearing qualities of leathers prepared by various tannages.

CONIFEROUS PRODUCTS.

Turpentine orcharding.—This investigation will be continued for this season along the lines already described. A comparative study of European and American methods on the ground will be undertaken and should be of very great advantage to the development of the new method now under experiment.

Distillation of pine woods.—The preliminary study already made of the distillation of waste Longleaf Pine butts for the production of turpentine and other by-products will be continued, with a view to its application to waste pine tops.

FOREST STATISTICS.

An effort will be made to begin the collection of data showing past and present consumption of raw and manufactured wood of various kinds for all purposes. The investigation is planned to include a considerable number of American and foreign woods in home and foreign markets and the production and value of forest by-products.

PRESERVATION OF WOOD.

The mechanical treatment of railway and other construction timbers with preservatives to increase their durability and comparative studies of the behavior and durability of treated and untreated timber in actual service will be continued. Further study of the causes of decay in timber and methods of prevention will be made. These investigations will be conducted in cooperation with the Bureau of Plant Industry.

TIMBER TESTS.

In cooperation with the Bureau of Chemistry, a series of tests to determine the strength of the principal merchantable timbers of the United States has been commenced. There is an urgent and widespread demand for reliable information of this kind, and it is intended to take up the work in a very thorough way. The Division of Forestry began in 1891 tests which related principally to the southern pines and which in 1896 were discontinued. Beyond this no systematic tests of American timbers have ever been made.

The work in timber testing now undertaken by the Bureau of Forestry will be of direct practical value to engineers and to others interested in the utilization of timber. Testing stations have already been established at Washington, D. C., and at New Haven, Conn., the latter in connection with the Yale Forest School, and their number will be increased as rapidly as possible. Experienced engineers will be employed in the laboratories, and the material will be collected by trained men.

FOREST ENTOMOLOGY.

In cooperation with the Division of Entomology, the study of the relation of injurious insects to practical forestry will be continued, and will include an investigation of the relation of insect pests to American osier willow plantations.

MISCELLANEOUS INVESTIGATIONS.

Pacific Coast Tan-bark Oak.—A thorough investigation will be made of the distribution and available commercial supplies of the Tan-bark Oak of the Pacific slope. Special attention will be given to the growth of the tree and its methods of reproduction. The importance of this investigation is very great, since the supply of this bark, which is the most valuable in the West, is rapidly decreasing, and its place can not be taken by material from any other western Tan-bark Oak.

Pacific cedar-shingle industry.—A study will be made of the cedar-shingle industry of the Pacific coast region. The industry will be investigated at the principal manufacturing centers, while a careful study will be made in the forest of the distribution, character, and extent of cedar timber available for shingles. So far as it is possible during the present season, a study will be made of the reproduction and silvicultural characteristics of this cedar.

RECORDS.

QUARTERS.

At the beginning of March, 1902, an entire floor of the Atlantic Building was added to the quarters of the Bureau. This addition was required by the congested condition of the rooms on the seventh floor. It permitted a rearrangement of the offices, the installation of the library, and the assignment of quarters to the photographic laboratory, hitherto in the building of the Bureau of Chemistry by the courtesy of the chief of that Bureau.

LIBRARY.

The transfer of the main collection of forest literature from the Department Library to the quarters of the Bureau was prevented by lack of space until March, 1902, when a large room was equipped for library purposes. The library now contains 1,120 bound volumes, 1,900 pamphlets, and files of 28 current forest and lumber-trade journals, including French, English, and German periodicals. There were added during the year 3,821 clippings from newspapers relating to forest work. The library staff was increased by the appointment of two librarians, making it possible to classify properly much valuable material collected in former years and to keep abreast of the current work.

The photographic collection was largely increased. Prints to the number of 3,643 were added during the year. Of this number, 3,235 photographs were taken in 42 States and Territories, and 408 forest photographs were received from foreign countries, including excellent collections from India, Switzerland, and Germany. These were classified, catalogued, and filed.

The collection now numbers 6,059 prints. Every State and Terri-

tory, including Alaska, Porto Rico, and the Philippine Islands, is represented. The collection of lantern slides now numbers about 1,000, of which over 400 were added during the year. Loans of 476 slides were made to 13 persons during the year.

CORRESPONDENCE.

As in preceding years, close attention was given to the expeditious handling of correspondence. Notwithstanding the large increase of mail matter, all letters received were promptly referred for attention, and, with few exceptions, were acted upon and acknowledged within thirty-six hours. The number of pieces of mail matter forwarded from the Bureau during the year was 24,538.

MAILING LISTS.

The mailing lists of the Bureau are the following:

(1) A special list of libraries.

(2) A list of representative newspapers.

(3) A small foreign list of journals, libraries, and individuals engaged in forest work.

(4) A special list of persons engaged in forest work in the United States.

(5) A general list of persons interested in forestry.

The first four lists, which number together 2,817 addresses, receive all publications of the Bureau as soon as they are available. To the general list are sent the reports of the Forester, reprints of the contributions from the Bureau of Forestry to the Yearbook of the Department, and circulars of information. Cards are also sent, giving notice of the appearance of bulletins, with brief descriptions of their contents. Applications for these bulletins, made in response to the card notices, are honored in the order of their receipt. The number of addresses on the general list is 5,056.

PUBLICATIONS.

New publications.—During the year eight new publications appeared, as follows:

	Copies.
Bulletin No. 31	7,200
Bulletin No. 32	10,000
Circular No. 23	10,000
Extract No. 212	15,000
Extract No. 214	10,000
Extract No. 236	5,000
Report of the Forester for 1901	10,000
Farmers' Bulletin No. 134	10,000
	77,200
Press Bulletins (Nos. 14, 15, and 16)	12,000
Total	89,200

A word of explanation is required concerning the number of new publications issued, without which it would seem that the publication of results had not by any means kept pace with the Bureau's activity in other directions. While but 2 new bulletins have appeared, as against 3 in 1901, there are now in course of publication 4 new bulletins, the manuscript of a fifth is completed and awaiting the beginning

of the new fiscal year before being submitted, and 2 additional extracts from the Yearbook will appear shortly. It is thus true that the work of publishing results has been carried on much more rapidly than ever before.

Reprints—Ten reprints of former publications were printed, as follows:

	Copies.
Bulletin No. 7	1,000
Bulletin No. 10, first edition	2,000
Bulletin No. 10, second edition	1,000
Bulletin No. 12	2,500
Bulletin No. 17	1,000
Bulletin No. 26	3,000
Bulletin No. 29	10,000
Bulletin No. 30	10,000
Circular No. 23	2,000
Extract No. 212	10,000
Farmers' Bulletin No. 134 (various reprints)	85,000
Total	127,500

In addition to the reprints listed above, the following are now in course of publication:

	Copies.
Bulletin No. 6	2,500
Bulletin No. 8	2,000
Bulletin No. 13	2,500
Bulletin No. 22	1,000
Bulletin No. 28	10,000
Total	18,000

PHOTOGRAPHIC LABORATORY.

Owing to lack of space at the quarters of the Bureau of Forestry, the photographic laboratory remained, as already mentioned, until recently, in the building of the Bureau of Chemistry, through the courtesy of the chief of that Bureau. With the acquisition of the eighth floor of the Atlantic Building it was possible to assign sufficient quarters for the equipment of a photographic laboratory. The work of installing the equipment is now completed. An enlarging and reducing camera of large size was purchased, and the laboratory is now thoroughly equipped in all branches of photographic work, including map photography, enlarging, reducing, and wet-plate work.

The work of the laboratory during the year was very satisfactory. Five thousand three hundred and thirty-two films and plates were developed, 9,695 prints were made, and altogether 20,884 items of work were performed.

INSTRUMENTS AND SUPPLIES.

Instruments.—The rapid extension of the work of the Bureau in the field made heavy demands for additional instruments, while experience in the woods suggested improvements in the construction of several types. A very small percentage of field equipment was lost or damaged beyond repair, for the members of the field parties were generally careful in the handling and use of the instruments. The total expenditure for instruments during the fiscal year was $7,245.61, or 3.9 per cent of the total appropriation.

Supplies.—With the exception of $400 from the contingent fund of the Department, all furniture, typewriting machines, stationery, and supplies of all kinds have been purchased from the funds appropriated for the Bureau of Forestry. This expenditure was $10,200.74, or 5.5 per cent of the total appropriation.

Accounts.—At the beginning of the fiscal year 1902 a system of accounts was introduced, the principal object of which, in connection with the proper preparation and handling of vouchers for the payment of salaries and expenses, was to furnish at all times an accurate, comprehensive, and permanent record of the condition of the appropriation for the expenses of the Bureau, and of the several allotments made by letters of authorization for the traveling expenses of members of the Bureau engaged in field work. A system setting forth in detail the allotments and liabilities of every class has been submitted at the end of each month to the chief of the Bureau.

Tree Planting.

The work of this section has broadened steadily during the past year. Cooperation with forest planters under the provisions of Circular No. 22 was widely extended, met with a high degree of public appreciation, and remains the most important work with which the section is charged. Other lines of work of equal promise originated during the year. The first National reserves for the distinct purpose of forest planting were established. It was fairly proved that some lands, hitherto considered incapable of doing so, will stock themselves without planting, if well directed assistance is given to the natural reproductive power. The reclamation of the coast sand dunes by forest planting was for the first time undertaken by the Bureau.

COOPERATIVE PLANTING.

On June 30, 1901, there had been received in response to the offer of cooperation with forest planters, announced in Circular No. 22, a total of 192 applications for assistance. For 173 applicants planting plans had been prepared, in the course of which 113,842.3 acres were examined. Probably 10 per cent of this area will be planted within twelve or fifteen years, but the detailed plans, made in consequence of the examinations, covered but 3,057 acres, which is the area to be planted within three or four years from the date of the plans. Where the planting was not extensive, in many cases it is now complete and in others it is near completion, for many landowners began planting at once on receipt of their plans.

This planting has generally given satisfactory results. For example, at Fowler, Kans., the main part of a wood lot of 12 acres has been established without losing a single tree. At Enid, Okla., satisfactory results were obtained in establishing a wood lot of 5 acres. In a few instances the planting has been temporarily deferred, and in two cases the agreements have been canceled because they could not be carried out by the owners.

During the past fiscal year 70 applications for assistance were received and 51 planting plans were made. There was examined an area of 83,596.9 acres, a large percentage of which is subject to planting. The area actually covered by the plans made during the year, and to be planted within the next two or three years, is 3,417.57 acres.

The total number of applications to June 30, 1902, is 262, the number of plans prepared 224, the area examined, 197,439.2 acres, and the area to be planted, 6,474.32 acres. Thirty-eight applications await attention.

The plans represent 29 States and Territories and 172 localities. In addition, personal advice and instruction have been given in these localities to many other planters. It has been the practice of the representatives of the Bureau in this work to attend and address local meetings when such are called in the interest of forestry by the citizens of a community where work is being done. At Anthony, Kans., where such a meeting was held last summer, over 500,000 trees were set out this spring in consequence, in addition to the planting under plans regularly prepared in that locality.

Planting under this year's plans has several purposes. Protective shelter belts and farm wood lots have generally been the object in the Middle West. Several commercial plantations are being developed in Oklahoma, Kansas, and Nebraska for fence posts and telegraph poles, though none is of great extent. An average example is a plantation at Stafford, Kans., which covers 30 acres and has for its object the production of fence posts. The Middle West has comparatively little nonagricultural land, and except for the production of fence posts, telegraph poles, and railroad ties, forest planting will not as a rule be practiced by individual planters on a larger scale than farm wood lots and shelter belts. The Eastern States have a high percentage of land adapted only to forest purposes, a good part of which has been stripped of timber beyond the hope of natural reproduction. Such land often lies within reach of good lumber markets. In many places in New England land worth from $2 to $5 per acre can be stocked with White Pine at fair annual profit on the investment, reckoning lumber at present prices and a period of growth of from forty to sixty years, and this has encouraged many land owners to begin planting on their idle lands.

An increasing amount of forest planting is being done for the purpose of protection, and this Bureau is giving practical aid in several cases of this nature. For example, the most extensive planting in New England is being done by the Metropolitan Water and Sewerage Board of the Commonwealth of Massachusetts, for the purpose of protecting from silt the immense reservoir under construction at Clinton, Mass., to supply Boston and surrounding cities with water. Seed beds, in preparation for this planting, were established two years ago. Planting was begun this year under plans prepared by the Bureau and carried forward with a force of 48 men under the immediate direction of a forester privately employed. One hundred and seventy-five acres were planted. It will require three years more to complete the planting at present planned, which will cover 1,500 acres. Seedlings are already on hand for the planting of this area, which is, however, but half of that which the plantation will eventually occupy.

In no case has the Bureau furnished seeds or trees or participated in any degree in the expense of planting. Its outlay is limited to the expenses of its agents in making the preliminary examinations and planting plans.

STUDIES OF PLANTED WOODLANDS.

Reliable advice and instruction in forest planting must be based upon a thorough knowledge of the purposes for which planting is

practicable, and of the methods to be economically employed in various regions. This knowledge can be obtained only by an exhaustive study of plantations already established. Such a study was vigorously pursued, during the past year, along the lines already established, in 20 large plantations, 8 of which are located in the Middle West and 12 in the East. The study of the Hardy Catalpa for economic planting was completed, and a bulletin based upon it is in press. A study of the White Pine for economic planting in New England is in progress, and a report is in course of preparation.

Closely connected with these investigations is a study now under way with the object of finding trees better adapted to the Southwestern plains than those hitherto in use. Types of trees inured to hard conditions of climate and soil in other regions are being introduced, in the hope that trees thoroughly fitted for the situation may be discovered.

STUDIES OF FOREST EXTENSION.

The study of the practicability of forest extension by assisting natural reproduction was begun two years ago in the timber belts which project into the prairies along the streams of the Middle West. During the past year this study was much advanced by a forest survey which included a large portion of Nebraska. It was found that the forests of that State, which consist mostly of narrow belts along the streams, have extended over large areas of prairie land within the last twenty-five years, where they were protected from fire and stock. It is estimated that in eastern Nebraska, where the timber is confined to hardwoods, the growth of the forest through its encroachment on prairie land amounts to not less than 400 square miles. The extension of the forest is noticeable on almost every stream and ravine. The forest is known to have traveled up certain streams as much as 2 miles and to have taken complete possession of tracts of 80 to 100 acres of prairie lands within the last twenty-five years.

A knowledge of how to assist natural reproduction effectually will be useful throughout the Middle West, where there are hundreds of scantily wooded stream valleys which should support a heavy stand of timber. Such knowledge will also be of much use in dealing with the denuded lands in the Eastern States, especially where reproduction has been prevented by repeated fires. It is likely to be of greatest value, however, on the National forest reserves, where the stand of timber is often deficient and in the management of which time is often a less important factor than on private lands.

RESERVE PLANTING.

The first step in this important work was taken this year. In the forest survey made in Nebraska, convincing evidence was found of the adaptability of the sand-hill district of that State to the growth of forest trees. Bull Pine and Red Cedar are spreading over the hills naturally near the Niobrara River, a decided tendency toward shrub growth exists throughout the district, and the Government's experiment in planting conifers, made nearly fifteen years ago, has been attended with marked success. At the recommendation of Senator Dietrich, of Nebraska, supported by the Bureau of Forestry, the President, on the 16th of last April, established in the sand-hill region two forest reserves of a joint area of 208,902 acres. With the

consent of the Secretary of the Interior, the Department of Agriculture will establish nurseries and undertake forest planting on these reserves. Preparation for the work was begun this spring, and similar work on other reserves is about to begin.

SAND DUNES.

Work on the control of sand dunes by forest planting was begun for the first time during the past year. Dune control has become important in several parts of the country where serious damage is threatened to valuable property by the encroachment of sand. In southern Virginia and northern North Carolina a chain of immense sand dunes stretches north and south along the coast. These dunes are moving slowly landward, and within the last few years have become dangerous to the United States life-saving stations and to private property of large value. Last fall, at the request of a number of private owners, the Bureau made an examination of a district in Currituck County, N. C., and began work at one point to fix the drifting sand sufficiently to permit forest planting. In cooperation with the owners of the land, board fences and other structures were erected to alter the course of the most threatening dunes and to clear the superfluous sand from a plain about certain valuable buildings. The work was so successful that this spring the ground was in condition for the planting of beach grass, which is being used temporarily as a cover. With a fair growth of grass this season, forest planting on from 30 to 50 acres may be begun next spring. The forest, besides protecting the buildings, will yield a much-needed supply of fuel. At other points in the same district, which extends 30 miles along the coast, the Bureau is now giving similar aid. In addition to its direct use this work will have great value as an object lesson in dealing with the sand.

An investigation is also being made of the dunes formed by the drift sand along the Columbia River in Washington and Oregon. The dunes are destroying valuable orchards and rich agricultural lands. They form serious hindrances to transportation along the lines of the Northern Pacific Railway and the Oregon Railroad and Navigation Company. After a careful examination the Bureau will attempt to devise methods for controlling the movement of the sand. The Oregon Railroad and Navigation Company is assisting in the investigation.

EXPENDITURES.

The expenditures of the section of tree planting for the year were $16,616.86, or 8.9 per cent of the total appropriation. Of this amount 53 per cent was for salaries and 47 per cent for field expenses.

WORK FOR THE ENSUING YEAR.

The work in cooperative planting is giving highly satisfactory results and will continue unchanged. Increased attention will also be paid to protective planting, especially in the Eastern States.

Preparations for extensive planting on the Dismal River and Niobrara forest reserves in Nebraska will be pushed forward as rapidly as possible. Seed beds and nurseries are being put in readiness. A large collection of seed will be made this fall and nursery work will begin. Examinations will be made of other forest reserves, notably

those in Oklahoma, Colorado, Arizona, and southern California, to determine the advisability of systematic planting.

Careful studies will be made in Oklahoma and Arizona during the year to find methods of extending the present forest stand by improving the conditions for natural reproduction. In both regions field parties are already at work.

The reclamation of sand dunes, both along the coast and in the interior, is one of the large problems before this Bureau. Two field parties, one on the Atlantic coast and one on the Columbia River, will continue to investigate this problem during the present season.

REPORT OF THE CHEMIST.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C., September 8, 1902.

SIR: I have the honor to submit herewith my report of the operations of the Bureau of Chemistry for the fiscal year ended June 30, 1902, together with an outline of the proposed work for the fiscal year ending June 30, 1903, and an estimate of the probable expenses of the Bureau for the fiscal year ending June 30, 1904.

Respectfully,

H. W. WILEY, *Chemist.*

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

On the 1st of July, 1901, the old Division of Chemistry, the first of the Divisions organized in the Department of Agriculture, became by act of Congress and Executive order the Bureau of Chemistry. The enlargement of the scope of the work by reason of this change rendered necessary an entire reorganization of the working force and a redistribution of the subjects of investigation. To this end, with the approval of the Secretary of Agriculture, the work of the Bureau was divided into groups, and laboratories were established to which each group of work was assigned. The laboratories organized for the year's work were as follows:

FOOD LABORATORY.

To this laboratory, of which Mr. W. D. Bigelow was made chief, was confided the study of the composition, digestibility, and adulteration of human foods in the largest sense of that term, including foods in the ordinary sense, beverages, and condiments. Also to this laboratory was assigned the study of substances added to foods for any purpose whatever, of which preservatives, coloring matters, and leavening agents are types.

During the fiscal year of 1901–1902 the examination of imported foods, which was begun in 1898, was brought to a close, and the results were embodied in a report to the Secretary of Agriculture, and by him transmitted to the President. In the course of this work the examination of imported olive oils led to the observation that several oils were adulterated which have always been reported pure by laboratories using the standard methods usually employed in the examination of salad oils. The work on the subject of olive oils was therefore greatly increased. It is proposed to issue a publication on this

subject during the coming year which will include the results of the examination of imported oils obtained through the customs officers and in the open market in this country, of domestic oils obtained in the open market, and of both foreign and domestic oils which were obtained from the manufacturers, with as full details as possible regarding the process of manufacture and, wherever possible, with affidavits as to their purity.

The results of the examination of about 350 samples of canned meats during the preceding year were compiled and published in Part X of Bulletin No. 13 of the Bureau of Chemistry.

Some work has been done with the canned soups which were examined during the preceding fiscal year. The results have been compiled and the manuscript will shortly be submitted for publication.

A careful study of tropical fruits grown in Cuba and Porto Rico has been under way since early autumn, and it is proposed to examine as many typical fruits of those islands as can be obtained during one calendar year. This work is of more value because of the presence of a member of the food laboratory in Havana during the greater part of the year, who personally secured the samples. In addition to the examination of these fruits, samples of commercial fruit products have been obtained and will shortly be subjected to analysis in the laboratory.

In connection with the studies of the Pomologist relating to the question of cold storage of fruit, the food laboratory examined eight varieties of apples at the time of their introduction into the storage warehouse, again when they began to ripen, again when fully ripe, and finally when overripe. Owing to the press of work in the laboratory when this investigation was under way, the results were not as complete as were desired. Some valuable information was gained from them, however, and the way is well marked out for a more detailed investigation of the same question during the present year.

In cooperation with the Virginia experiment station, a number of varieties of apples, as well as pomace and must produced from them in the manufacture of cider, have been examined by the food laboratory. The results of this work have been incorporated by Mr. William B. Alwood in his bulletin on the manufacture of cider, which is now in press.

During the latter part of the fiscal year the wines for which prizes were awarded at the Paris Exposition of 1900, were examined in the food laboratory. These analyses are of great interest because of the fact that they are the only complete analyses of American wines that have been made for a number of years. All available analyses of American wines were collected by the Bureau of Chemistry two years ago and published in Bulletin No. 59. Some of the results there given are relatively recent, but the majority of them were obtained a number of years ago, some as early as 1861.

A comparison of the latest results obtained with those included in Bulletin No. 59 indicates that marked improvements have been made in the methods of fermentation employed in the United States. The percentages of volatile acid and sugar are much lower, while the percentage of glycerol is much higher in the recent examinations than in the earlier ones. Perhaps we are not warranted in saying that the industry on the whole has been improved to the extent indicated by such a comparison, but the number of samples examined was sufficient to warrant making the statement somewhat general. It is highly desirable that this work be extended.

An important part of the work of the food laboratory during the last fiscal year was that done at the request of other Departments. This includes samples from the subsistence departments of the Army and Navy and nonalcoholic beers from the Attorney-General and sheriffs in the Indian Territory. At the request of the Treasury Department an investigation was also made of pineapples, in order to determine as nearly as possible the amount of sugar that is added to the canned pines imported into the United States from the Bahamas and the Straits Settlements. To determine this a large number of imported canned pines were obtained, and also ripe pines, from as many localities as possible, including Florida, Cuba, Porto Rico, and the Bahamas. Arrangements have also been made to have samples of pines taken at Singapore preserved according to directions and shipped to the laboratory for examination.

The food laboratory has done an important work during the last fiscal year in collecting, investigating, and comparing methods for the examination of a large variety of foods. This work was taken up at the request of the Association of Official Agricultural Chemists, in which the chief of the food laboratory is at present the referee on food adulteration. He has worked in cooperation with 13 prominent food chemists of the United States and Canada in the preparation and collection of these methods. The results of their labor have been published as Bulletin 65 of the Bureau of Chemistry, which forms a better laboratory manual for the examination of the subjects it includes than any single reference book that has been published. Since this bulletin was published, three additional subjects have been treated by the chemists to whom they were assigned.

ROAD MATERIAL LABORATORY.

This laboratory, of which Mr. L. W. Page was made chief, was established in collaboration with the Office of Public Road Inquiries, and is not yet fully equipped. The installation of the laboratory began in December, 1900, and it was impracticable to begin work for several months, on account of the time necessary for even a partial equipment. Therefore the fiscal year ended June 30 last is the first year of operation of this laboratory.

The object of the road material laboratory is to obtain results, by means of physical and chemical tests, from small samples of road materials, to aid the road builder in selecting the most suitable material available, and to advise him as to the best methods of construction to be used in his work.

Up to the present time it has been possible to test only materials used for macadam, gravel, and clay roads. To properly meet the various conditions of traffic and climate to which roads are subjected with suitable road materials, it is necessary to carefully study the chemical and physical properties of these materials, and it is here that the principal work of the road material laboratory lies. In a broad sense, the value of any road material is dependent upon the degree to which it possesses certain physical and chemical properties, and these properties often depend on a peculiar chemical composition. The work of the laboratory therefore comes under three principal heads, viz, physical tests, for determining the degree to which a material possesses the essential physical properties necessary for good roads; chemical analyses, together with the chemical investigation of certain essential properties; and petrographic determinations of the various

rock samples, so that they can be properly classified according to their mineral composition.

The most important of the physical properties which are made subjects of investigation are: Hardness, or the property possessed by a material to resist the wear caused by the abrasion of the wheels of vehicles and horses' feet, and toughness, or the adhesion between the fine particles of a material which gives it the power to resist fracture when subjected to the blows of traffic. This property, while distinct from hardness, is intimately associated with it and can, in a measure, make up for a deficiency in hardness. Hardness, for instance, would be the resistance offered by a material to the grinding of an emery wheel; toughness, the resistance to fracture when struck with a hammer. Cementing value, which is probably the most important property to be sought for in macadam rocks, gravels, and clays, is the property possessed by the dust of these materials to act, after wetting, as a cement to the coarser fragments composing the rock, bringing them together to form a smooth, impervious shell over the surface. The degree to which a material absorbs water is also an important property, as is also the density of macadam rock.

All samples received at this laboratory during the past year have been subjected to the necessary tests for determining the degree to which they possess the above properties. They have also been analyzed chemically or petrographically, as the particular case required, and properly classified. Besides these standard tests, several new ones have been proposed and investigated.

In addition to the regular tests certain lines of investigation have been taken up, which, it is hoped, will be of benefit to the road builder. Among the most important of these is a study of burnt clays, together with the cementing value of clay. The results obtained from this work warrant the expectation that satisfactory roads can be built of moderately burned clay at a comparatively small cost. If this be true it will be of great benefit to those citizens of our country who live in districts where no hard materials for road building are available. It is the purpose of this laboratory during the present year to build an experimental road of burnt clay, in collaboration with the Office of Public Road Inquiries, and thus test in a practical way the results obtained in the laboratory.

During the past fiscal year 150 abrasion tests have been made, 184 cementation tests, 88 chemical analyses, 180 petrographical analyses, 150 absorption tests, and the same number of specific densities. Two hundred and seventy-one miscellaneous samples were received. These samples have come from all parts of the United States, including some of our new possessions, and in no instance has a sample been solicited in any way. They have come almost exclusively from practical road builders, endeavoring to lessen the cost and improve the quality of their work.

DENDRO-CHEMICAL LABORATORY.

Mr. W. H. Krug was made chief of this laboratory. It was organized in collaboration with the Bureau of Forestry for the purpose of instituting a complete chemical study of forest products in all their economical relations. The work done during the year ended June 30, 1902, was divided into the following groups:

(1) Researches, in cooperation with the Association of Official Agricultural Chemists, on analytical methods applied to feeding stuffs, and also on methods of analysis of tanning materials.

(2) Preparation and analysis of 300 samples of wood and bark taken from sections of *Quercus prinus*, *Quercus rubra*, *Quercus alba*, *Quercus velutina*, and *Tsuga heterophylla* (hemlock) supplied by the Bureau of Forestry.

(3) Examination of nine unidentified tree secretions from the Philippine Islands, to determine their possible identity with gutta-percha.

(4) Partially completed investigations on a series of tree secretions submitted by the Philippine Bureau of Forestry, which were fully identified before shipment.

(5) A comparative study of the properties of synthetic and native camphor.

(6) An investigation of methods for the extraction of guaiac resin from lignum-vitæ chips and sawdust.

(7) An extensive study of certain products obtained by a new process devised for the distillation of waste pine wood. The plant where this system is in operation was visited, and the principle of the process was made the subject of a special report.

(8) A partially completed study of the chemical composition and physical properties of American wood pulps and wood-pulp papers obtained from the manufacturers.

(9) A microchemical and histological study of the development of the cellular tissues of certain oaks which has been carried on by Mr. B. J. Howard. This work is almost completed and will be accompanied by a review of the literature on the subject.

(10) Preliminary work on the availability of certain hitherto unused woods as a source of wood pulp.

(11) Preliminary work on chemical methods for killing useless timber.

(12) Analysis of 22 samples of indian corn for the Division of Botany.

(13) Determination of the cellulose and pentosans in 30 samples of fruit for the food laboratory.

(14) The preparation of a card index covering all chemical literature bearing on dendro-chemistry.

SUGAR LABORATORY.

Mr. G. L. Spencer was made chief of this laboratory, and the analytical work for the year ended June 30, 1902, included analyses of sirups, sugars, sugar beets, sugar cane, etc. The total number of analyses was 2,439, distributed as follows:

Miscellaneous samples	32
Sugars in cooperation with the Treasury Department	775
Sugars for the War Department	5
Sugar cane	146
Sugar beets grown on the Department's farm	80
Sugar beets from the State experiment stations	45
Sugar beets, miscellaneous samples	1,338
Sorghum cane	7
Melons	11
Total number of samples	2,439

The work of the sugar laboratory included also the preparation of replies to letters concerning the sugar industry in general, the editing of the manuscript for Farmers' Bulletin No. 135, "Sorghum sirup manufacture," and the correction of the proof sheets and the revision of Farmers' Bulletin No. 52, "The sugar beet."

The purpose of the sugar laboratory is to study from a chemical point of view all aspects of the sugar industry, including therewith those nearly allied carbohydrates, starches. The work covers practically the chemical studies and related techno-chemical industries having for their object the manufacture of sugar or starch, or their products, in any form, or for any purpose. The sugar industry is preeminently one which has depended for its development on chemical research, and it is safe to say that the beet would still be only a garden vegetable, devoid of any practical utility for sugar making, had it not been for the impetus given to its development by chemists.

The most important collaborative work of the sugar laboratory has been in the study of the composition of the sugar beet as affected by environment, in which this laboratory has had the assistance of the Weather Bureau in collecting and preparing the meteorological data in various parts of the country where experiments were conducted; also the valuable collaboration of the North Carolina, Iowa, Michigan, Utah, Virginia, Indiana, Wisconsin, Kentucky, and the two New York experiment stations, which have consented to furnish the agricultural data in connection with the work, and also to duplicate the chemical analyses.

Other interesting and valuable work of the sugar laboratory has been the collaborative study of the composition of muskmelons as affected by environment. In this work the laboratory has had the collaboration of the following experiment stations for the agricultural data and also for duplicating the chemical analyses: New Jersey, California, Colorado, Delaware, Arizona, North Carolina, Kentucky, Indiana, Texas, and Maryland.

INSECTICIDES AND AGRICULTURAL WATER LABORATORY.

Of this laboratory Mr. J. K. Haywood was made chief. In some instances it has been necessary to put more than one group of investigations in one laboratory, as the equipment of the Bureau would not permit the formation of a separate laboratory for each subject of study. For this reason the subjects of insecticides and agricultural waters have been placed in one laboratory.

During the year ended June 30, 1902, the study of the composition of the springs on the Government reservation at Hot Springs, Ark., undertaken in cooperation with the Interior Department, was completed, and the results compiled and forwarded to the Secretary of the Interior, who had them published as Senate Document No. 282. This work shows the composition of all the hot springs, explains their medicinal qualities, and gives very complete methods for the analysis of waters of this class.

In collaboration with the Division of Entomology, this laboratory has made analyses of about 160 samples of insecticides, fungicides, and disinfectants, gathered from all parts of the United States. The work done upon this subject has been published in a popular form as Farmers' Bulletin 146, and in a more technical and complete form as Bulletin No. 68, of the Bureau of Chemistry. The methods of analysis used, many of which were devised for the work, are given in the latter bulletin. The results of this work show that many of this class of preparations are of little or no value for the purpose intended, while many more that could just as well be prepared by the farmer are sold at an exorbitant rate. Objection has been made on the part of various manufacturers of proprietary articles used as insecticides and

fungicides to the right of the Department to make analyses of their products and to publish the results. In this connection, it may be mentioned that it is not the object of these investigations to in any way injure the business of any reputable manufacturer. It is hard to see, however, how publicity in regard to these matters can be objected to. The interests of the farmers and others using these bodies is of first importance in these investigations. If it be true that many of these bodies fail to possess the properties attributed to them, the manufacturer is as much interested in knowing this as the consumer, because it may be assumed that no reputable manufacturer would desire to continue to place upon the market an article which is less valuable than it is claimed to be. If, however, occasion should ever arise where a manufacturer, after being informed of the nature of a body, should desire to continue to sell a practically worthless preparation, it seems only proper that the public should be informed in regard to the exact character of the article offered.

In every instance, before publication, the analyses of these bodies are submitted to the proprietors, and they have always ample opportunity to make any representations in regard to the matter which may seem proper to them. Especially, if our analysis is in error, and this must necessarily sometimes happen, the proprietor of the article has the oportunity to point out the mistakes which have been made, in which case an attempt is always made to rectify them before publication. It seems, therefore, that studies of this kind are well suited to protect both the interests of the manufacturer and the consumer, and that no reasonable objection can be raised against them.

During the past year work was begun, also in collaboration with the Division of Entomology, on the amount of free arsenious oxid which may be present in Paris green used for spraying, without injury to the foliage. This work will be of great value and will enable the State experiment stations to determine the value of any particular sample of Paris green for spraying purposes.

Work was also begun during the past year upon a study of the arsenic content of papers, wall papers, tapestries, and fabrics of various kinds. It is a well-known fact that the presence of large quantities of arsenic in these goods is injurious to health.

In collaboration with the Office of Experiment Stations (irrigation investigations), work was begun upon a study of the water used for irrigation purposes in the Western States, and especially in the rice belt of Texas and Louisiana. It is expected that this work will be of immense benefit to rice growers in enabling them to determine what waters are most suitable for their purpose. An important feature of this work is a study of the effect of the backing up of sea water consequent upon the pumping of large quantities of water out of the low streams of Louisiana. If the content of salt in the river rises to such an extent as to be injurious to the rice crop, the irrigation investigations office will endeavor to make suggestions and assist the rice growers to other means of irrigation.

Many samples of insecticides and fungicides have been analyzed during the year in this laboratory, together with numerous samples of irrigation waters. In several instances the water supply of small cities has been examined to determine its healthfulness.

The chief of this laboratory having been appointed referee on insecticides and fungicides for the Association of Official Agricultural Chemists, a large amount of work was done in cooperation with that

association. Many new methods of analysis of this class of compounds were devised and tested and samples for analysis sent to 14 different chemists for purposes of comparison.

SOIL LABORATORY.

Since the chemistry of the soil is the foundation of agricultural chemistry, a special laboratory, with Mr. C. C. Moore as chief, has been established to study the chemical composition of the soil and the best methods of analysis.

This laboratory has continued in a line of soil investigations which were commenced in the Division of Chemistry about seven years ago. Its specific work has been to devise methods whereby the amount of mineral matter in a soil in a condition to be assimilated by plants may be estimated, the purpose being to forecast and supply those ingredients which would have been found deficient by the growing plant. After a very elaborate series of pot experiments upon the growth of oats, beans, and buckwheat, a scheme for the determination of the amounts of phosphorus pentoxide and potash available for the plant was devised.

In the early part of the year a unification of the laboratory studies was undertaken by a direct application to the actual conditions of field crops. Accordingly, a series of plot experiments was begun in Tennessee upon the growth of oats. Tennessee was selected for these experiments because of the many varieties of soil and geological formations found in that State. About 25 plots were grown, ranging the full length of the State. Samples of the soil and subsoil were taken at the time of seeding. These samples were analyzed, and from the results a conclusion was drawn as to the amount of phosphorus and potash which would probably be utilized by the plants in the course of their growth. At the maturity of the crop a sample of soil was secured from an accurately defined area. From the analysis of this sample the amount of mineral matter removed was calculated, and the results were compared with the forecast as made from the previous analysis of the soil. Very significant results were obtained, and owing to the vast importance of such an investigation it was decided to extend the scope of the work and verify the results by an extensive application of the theory throughout the United States.

Accordingly, a cooperative plan of study was arranged. A circular outlining the nature of the work was prepared and sent to the various agricultural experiment stations. Twenty-eight stations agreed to undertake the work. The plan, in brief, is as follows: Each station selected a typical soil, preferably one that had received no fertilizer, which was considered the best suited for the purpose. Four adjoining plots of cereals were sown—spring wheat, oats, rye, and barley. From the center of the plots and over an area of about 4 square feet samples of soil were secured to three successive depths of 9 inches. The soils and subsoils were shipped to this laboratory, where a portion was used for the experimental culture in pots and the remainder redistributed among the cooperating stations for analysis and study.

At maturity the crops are to be harvested and forwarded to this laboratory, where they will be analyzed and the amount of mineral matter removed will be calculated.

This is probably the most extensive chemical investigation of methods to determine the fertility of soil which has been undertaken. Each

cooperating station was supplied with 54 samples, representing the soils and subsoils from 27 States, and with the analyses of the four varieties of cereals grown on these soils. There was also supplied to each station a piece of apparatus designed by this laboratory, whereby 12 samples of soil may be simultaneously subjected to specified constant conditions of digestion, viz, a definite temperature and the continuous agitation of the soil in its solvent. With this equipment the cooperating stations will endeavor to verify the scheme of analysis, as outlined by this laboratory, and in addition such theories as have been or may be proposed by authorities on this subject.

A study of some of the sugar-cane soils of Georgia and Florida was made in this laboratory during the past year. Sixty-five samples of these soils were subjected to a complete chemical study, and the data obtained have been compiled and incorporated in a bulletin on the manufacture of cane sirup.

The analytical work for the past year consisted of the analysis of 140 soils and 375 crop samples.

FERTILIZER LABORATORY.

Intimately connected with the laboratory devoted to the study of the composition of soils is the one which has in charge the study of domestic and commercial fertilizers. To this laboratory, of which Mr. E. G. Runyan is chief, samples of soil are referred when the object is simply to determine the quantity of plant food or fertilizing material which they contain.

The work done in this laboratory during the year ended June 30, 1902, included complete or partial analyses of the following materials:

Mineral or natural products	26
Fertilizers	40
Aqueous soil extracts	6
Soils	112
Miscellaneous samples	37
Total	221

The purity of chemicals purchased for the use of the Bureau has also been determined in this laboratory, and a record has been kept of all samples received in the soil, fertilizer, and various other laboratories.

A considerable amount of time and labor has been given to the testing of new and proposed methods of analyzing and valuing ashes and other fertilizing materials, much of this work being carried on in cooperation with the Association of Official Agricultural Chemists.

ŒNOLOGICAL INVESTIGATIONS.

This Bureau has continued during the year ended June 30, 1902, the œnological investigations of the previous year in collaboration with Mr. William B. Alwood, of the Virginia Agricultural Experiment Station. The chemical work in connection with these investigations was done chiefly in the laboratory of this Bureau, but we are indebted also to Mr. R. J. Davidson, the chemist of the Virginia Agricultural Experiment Station, for a large amount of work which he gratuitously contributed to these investigations. This work was classified under two heads, viz:

First. The collection and forwarding of various fruits for chemical analysis with a view to a complete study of the composition of American fruits. This work was done with the special object of gathering

necessary data to assist in the study of the technique of cider, wine, and vinegar fermentation, so that we may be better able to handle the large amount of our fruits falling below merchantable grade, and to determine the value of certain varieties for the manufacture of the products mentioned.

Second. The isolation and study of the organisms which cause fermentation, both vinous and acetic, and also malfermentations which tend to destroy the products sought to be secured and conserved. In this study the prime data sought are the chemical changes produced in fermenting fruit musts or saccharine solutions of all kinds, and the determination of the best methods of bringing about these chemical changes in the most practicable manner, and conserving with certainty the desirable products formed from further changes by reason of malfermentation.

Under the first head, a considerable number of different varieties of apples has been collected and analyzed during the year. This has served for the beginning of a comprehensive study on the chemistry of fruits. In the course of this preliminary work it has been found that the methods of analysis are not well perfected, and as a consequence it has become necessary to take up this whole subject anew. This work will be continued on all our native fruits and berries which have commercial importance.

Under the second head, a considerable number of alcoholic ferments, belonging to the genus Saccharomyces, both from foreign wines and ciders and those of American production, has been separated and reduced to pure cultures. The study of these organisms as to their chemical reaction on fruit musts and saccharine solutions is well under way and promises most interesting scientific and economic results. In the study of the alcoholic ferments proper, numbers of organisms have been detected and isolated which are closely related to the above-mentioned genus Saccharomyces, but which from the nature of their reaction upon fruit musts are denominated malferments, because they destroy or injuriously alter those products which it is desired to conserve. The critical study of these organisms awaits a convenient time.

This kind of work on fermentations is too new a field of investigation to warrant a positive statement in regard to its importance, further than to say that it is studied in Europe in the most assiduous manner in the Government laboratories, and makers of wines, ciders, and vinegars assert that the laboratory results are used by them with the greatest benefits. In the experiments in the use of pure cultures of the alcoholic ferments at the Virginia Agricultural Experiment Station most excellent ciders have been produced.

There is a further application of this investigation, viz, the employment of these and allied organisms for the inversion of starch, in the manufacture of commercial compressed yeasts, in the inversion of nonfermentable sugars to fermentable forms, and in the differentiation of sugars by the use of specific organisms brought to a state of pure culture. This line of inquiry promises to be of great importance, both in the chemical laboratory and in the practical application of chemistry to the arts and manufactures.

MISCELLANEOUS INVESTIGATIONS.

As in previous years, the Bureau of Chemistry has been called upon during the past fiscal year to make a number of analytical and other

investigations for other Bureaus and Divisions of the Department and for other branches of the Government. Some of these investigations are of such a character that they are referred to the special laboratory appropriate in each case. Many, however, have been of such a character as not to fall within the lines of work of any of the special laboratories, and have been investigated by or under the direction of the assistant chief of the Bureau.

As a noteworthy example, there may be cited from the work of the past fiscal year investigations undertaken at the request of the Division of Entomology, to ascertain the extent of the danger from fire and explosion attending the use of carbon disulphide as an insecticide. The results of this work have been published in Farmers' Bulletin No. 145.

Perhaps the most important class of these miscellaneous investigations is the control, by means of chemical and physical tests, of materials purchased by this and other Departments of the Government. Many large corporations, both municipal and private, are establishing as thorough a scientific control as practicable over all purchases of supplies made by them. It is to be regretted that instead of leading in this movement most if not all of the Executive Departments of the Government have failed to make any considerable use of this valuable means of controlling the quality of materials purchased. This is of especially great importance for the Government, because practically all supplies are purchased on the basis of competitive bids, a system which requires the utmost precision in all specifications.

Progress has been made, however, as is evidenced by the increasing number and variety of materials submitted to this Bureau by various branches of the Government for examination in regard to purity, quality, etc. Among the notable examples of the past fiscal year may be mentioned extensive investigations relative to canceling inks for the Post-Office Department, the analysis of samples of coal for the Interior Department, etc.

The work included not merely the analysis of samples submitted, but also investigations undertaken with a view of obtaining data for the formulation of specifications which will not only give analytical results more meaning and value, but which will enable the bidders and purchasing officers to agree in regard to the exact meaning of specifications. Rigid specifications are of great importance, not only for the protection of the Government, but also for the protection of bidders of the best class. Advantage will accrue to the Government because the quality of supplies furnished can be accurately ascertained. On the other hand, bidders will be benefited by the removal of all doubt as to the quality of goods to be furnished. Bidders of the best class will therefore be protected from the competition of vendors of inferior goods.

The supervision of the sugar laboratories of the ports of Philadelphia, New York, and Boston, assigned a few years ago by an agreement between the Secretary of the Treasury and the Secretary of Agriculture to this Bureau, has been continued. A sample from each of these laboratories is sent each day for comparative analysis. Each month a summary of the analyses of these samples is compiled in order to determine the reliability and the accuracy of the work. From time to time, as the exigencies of the service may require, personal inspection is made of the sugar laboratories and comparative polarizations secured on the samples of sugar and standard quartz plates, in

order to insure the accuracy of the instruments in use. When it is considered that the duties on imported sugars amount in round numbers to $60,000,000 annually, and that these duties are laid in accordance with the polarizations of the sugar imported, the importance of securing a rigid and accurate control of the processes is at once apparent.

Many other problems connected with the collection of duties have been referred by the Treasury Department to this Bureau during the past year. One of the most important of these investigations relates to the rate of duty which is levied upon imported pineapples preserved in cans. The law requires a certain rate of duty to be collected on imports of this kind when the pineapples are preserved in their own juice and a different rate of duty if sugar be added in the process of preserving. A difference of opinion having arisen between the appraisers and importers in regard to this matter, the solution of the difficulty by mutual consent has been left to this Bureau. In order to reach a conclusion large numbers of analyses of imported products, as well as of the original pines, have been necessary. This work was only partially completed at the end of the fiscal year, but will be brought to completion during the present fiscal year.

The question of the exclusion of certain articles of food which may contain injurious products has also been referred in several instances to this Bureau by the Treasury Department since, under the existing laws, such exclusion is secured only on certification from the Secretary of Agriculture to the Secretary of the Treasury that the articles in question are injurious. Investigations have been carried on during the past year relative to some of the principal preservatives, and as a result of these investigations certain regulations have been formulated by the Secretary of the Treasury respecting the use of sulphur on fruit products preliminary to desiccation, preservation, and shipment. Under these regulations, when their details are carried into effect, the wholesomeness of the imported articles is not impaired, while their appearance is rendered more agreeable by the previous application of fumes of burning sulphur. Since the process of sulphuration, which is the application of fumes of burning sulphur to fruits previous to desiccation or preservation, is practiced generally throughout the world and since when properly conducted no injurious effects are produced upon the product, it is hoped that the policy established by this Government in relation to such products will be adopted by other nations. Some American fruit products have been subjected to restriction or exclusion in foreign countries by reason of alleged application of sulphur in the manner described, and we believe that these restrictions and exclusions do not rest upon justifiable grounds.

PROPOSED WORK FOR THE YEAR ENDING JUNE 30, 1903.

The work outlined in the above report for the laboratories mentioned, and which has already received the approval of the Secretary, will be continued during the fiscal year ending June 30, 1903, as follows:

FOOD LABORATORY.

During the present fiscal year the work described in the first part of this report with olive oil, pineapples, tropical fruits and their manufactured products, the ripening of fruits, and the manufacture of

cider will be continued. Some time will be devoted to the study of polariscopic and reducing methods for the determination of sugar, in cooperation with the sugar referee of the Association of Official Agricultural Chemists.

The most important new line of work that will be inaugurated will be the study of infant and invalid foods, of which a large number is now on the market. This will be taken up early in the autumn, and will probably occupy the time of a portion of the force during the full calendar year. An examination relating to nonfermented beverages and flavoring extracts on the market will also be made.

ROAD MATERIAL LABORATORY.

During the current fiscal year the same tests referred to in the first part of this report will be carried on, and the demand for them will doubtless be much greater. Besides these tests, the necessary appliances have been installed for testing paving brick; and as the use of brick for road paving is increasing very rapidly, and as the testing of brick is most essential, this work will doubtless be one of the important features of this laboratory.

It is also intended to make certain investigations in the mixing and burning of clay for the purpose of obtaining methods for getting the necessary properties essential to good paving brick.

The testing of cements and concretes will also be an important part of the laboratory work, as concrete is not only used extensively in road foundations, but for drainpipes and sidewalks as well. The equipment for carrying on this work has been partially installed and the work will soon be taken up.

Wood blocks have long been used in Europe with great success for paving streets, and their introduction into this country, with modern methods of preserving the wood, is met with favor. When properly treated there is no material better suited to heavy traffic than wood blocks. They are sanitary, and probably give less noise and dust than any other form of pavement. The importance of investigating the proper methods of preserving wood is so essential that the subject has been taken up in collaboration with the Bureau of Forestry, and it will be made an object of study during the current year. The Bureau of Forestry has supplied this laboratory with two most essential testing machines for carrying out the physical tests on wood blocks, and the dendro-chemical laboratory of this Bureau will investigate the chemistry of the subject of wood preservatives.

The necessary expert assistance during the year will more than absorb the total allowance which has been made, and the additional funds necessary, together with all incidental expenses of the laboratory, will be supplied from the miscellaneous funds of the Bureau of Chemistry.

DENDRO-CHEMICAL LABORATORY.

The work outlined for this laboratory for the present year is as follows:

(1) Continuation of the analytical studies on the composition of the wood and bark of certain American oaks and hemlocks.

(2) Extension of the work on American wood pulps and wood-pulp papers in connection with the investigation on the availability of certain woods as a source of wood pulp, the ultimate object being the creation of a paper-testing laboratory which shall exercise an intelli-

gent control over the purchases of paper made by the United States Government. In connection with these plans, suitable apparatus has been designed for determining the physical properties of various papers. The work will also include extensive microscopical studies of the fibers.

(3) Cooperation with the Association of Official Agricultural Chemists on analytical methods applied to feeding stuffs and tanning materials.

(4) Continuation of investigations on the composition and commercial value of new forest products obtained in our island possessions. Arrangements have been made with the Philippine Bureau of Forestry whereby such materials will be systematically collected and sent to this laboratory.

(5) A study of the extent to which American turpentine is adulterated.

(6) An investigation of the composition and relative wearing quality of American tanned sole leather. A machine for determining the wearing quality has been built and will shortly be placed in position. Arrangements have been made for the collection of a large number of samples of such leather.

(7) A study of the effect of dry and moist heat on the physical properties of wood. At the request of this laboratory the Bureau of Forestry has purchased a Riehle testing machine, which will be placed in the road-material laboratory and will be used for comparative work.

(8) A continuation of the investigation on chemical methods for killing trees.

(9) Further studies on the chemistry and histology of the cellular tissues of the wood and bark of trees.

In addition the laboratory will, as heretofore, carry on cooperative work with the other Bureaus and Divisions of the Department, in so far as this work comes within the province of its special lines of investigation. The work on the card index embracing all literature bearing on dendro-chemistry will be continued. A review of recent progress in this field is contributed every month to Forestry and Irrigation, the official organ of the American Forestry Association and the National Irrigation Association.

SUGAR LABORATORY.

The work proposed for the current year is a continuation of the collaboration with the Weather Bureau and agricultural experiment stations in studying the effect of environment upon the chemical composition of plants. Since sugar and starch, together with other carbohydrates, make up by far the greater part of the organic matter of which plants are composed, it is evident that these studies will be carried on almost exclusively in the sugar laboratory. In addition the laboratory will make the following studies and investigations:

(1) Investigation of raw materials and products for the advancement of the sugar and allied industries. This will include an investigation of the sirup industry, with a view to the production of a more uniform product; the analysis of samples of sugar cane, sugar beets, and such other analytical work as may be necessary in a study of the problems constantly arising in these industries.

(2) The analysis of sugars in cooperation with the Treasury Department.

(3) A study of methods of analysis in cooperation with the Association of Official Agricultural Chemists.

(4) Preparation of reports and replies to inquiries relating to sugar and other carbohydrates.

INSECTICIDES AND AGRICULTURAL WATER LABORATORY.

Arrangements have been made with the Division of Entomology to continue the collaborative work on the composition of insecticides and fungicides as they appear on the market.

Work will be continued, in collaboration with the same Division, on the amount of soluble arsenious oxid which may be present in Paris green and other arsenical insecticides without injury to the foliage resulting from their use. Such work will also be taken up in collaboration with the agricultural experiment stations, since climatic conditions have a marked effect on the action of soluble arsenious oxid on foliage.

Work in collaboration with the Office of Experiment Stations (irrigation investigations) will be continued upon a study of the irrigation value of the waters of our Western streams, and especially of the waters in the rice belt of Texas and Louisiana. Samples will be collected, according to special instructions, and analyzed in this laboratory.

The work begun on a study of the arsenic content of wall papers, fabrics, etc., will be extended and pushed vigorously, and a thorough investigation of these articles on the American market will be made.

Analyses of miscellaneous samples of insecticides, fungicides, and irrigation water will be made for farmers upon application for such work.

An investigation of the mineral and drinking waters now sold upon the American market will be made. This study will be of great scientific and practical importance, since it is believed that many waters are advertised to contain ingredients possessing marked medicinal qualities which either do not contain such ingredients at all or at most only in traces. The drinking waters will also be examined as to their effect on the health of the consumer.

A study will be made of as many samples of pyrethrum as can be obtained to determine if lead or barium chromate have been added to give them a bright yellow color. This laboratory has found that these two substances are often used in insect powders, a practice which is extremely reprehensible, since it is known that both lead and chromium are poisonous to human beings when inhaled.

It is hoped that during the present year an investigation of the quality of the water used in dairies and creameries may be begun. Practical suggestions can then be made as to the purification of such water supplies, it being a well-known fact that much disease is caused by washing cans in impure water and that the keeping quality of the butter is much influenced by the character of the water supply.

SOIL LABORATORY.

The work during the current year will be a continuation of the cooperative work with the stations, as outlined in the first part of this report. This laboratory will undertake the analytical work in connection with these studies, leaving the stations free for research work.

A study of the hemp industry of Kentucky will be taken up during the present year. This will comprise an examination of the typical hemp soils, together with a study of the crops which are grown thereon. In conjunction with this chemical work an economic investigation of the hemp industry, with reference to the methods of culture, yields, manner of preparation, uses, and markets, will be made. There have been collected 80 samples of soil representing the hemp section, and at the time of harvest samples of the crops grown in the locality where the soils were obtained will be secured.

This laboratory will have its annual routine work in the analysis of the crop samples from the pot-culture experiments. In addition, it will make analyses of the soils used in the pot experiments.

DAIRY LABORATORY.

During the last year the dairy laboratory was transferred to the Bureau of Animal Industry. By the order of the Secretary of July 1, 1902, the dairy laboratory was again placed in the Bureau of Chemistry, but no appropriations have been made therefor. Previous to January 1, 1902, this laboratory was in the Bureau of Chemistry, but the expenses thereof were charged to the Bureau of Animal Industry. Now that this laboratory has been permanently restored to the Bureau of Chemistry, it is necessary to make a special estimate for its maintenance, and this has been done in the estimates which follow. Five thousand dollars will be sufficient to carry on this work for the first year, unless the collaborative work with the Bureau of Animal Industry should be larger than is anticipated. It is necessary in this work, upon which the officers of the law often depend for analytical data, to be thoroughly equipped to secure such data promptly, in order that the execution of the law may not be delayed.

ŒNOLOGICAL INVESTIGATIONS.

The importance of the œnological investigations in the manufacture of wines and ciders has already been set forth in the first part of this report. The improvement of the character of cider which has been secured is most marked, and no greater benefit could be conferred on our cider makers than the continuance of this work, in order that the best methods of fermentation and cellar treatment for ciders may be pointed out, and also that the fermentation germs which make the best flavored products may be provided and distributed to them. What is true of ciders is also true of wines, although our investigations have not yet extended further than the analysis of the wines themselves. The importance of this work is such as to warrant the establishment of a special laboratory in the Bureau of Chemistry for its conduct, and an estimate for $5,000 for this purpose has been submitted.

MISCELLANEOUS INVESTIGATIONS.

Our increasing knowledge of the importance of microorganisms, in connection with the changes which take place in soils and manures, is constantly presenting chemical problems of great scientific interest and importance. Most of these problems are so strictly chemical in their nature that they can only be successfully investigated in a well-equipped chemical laboratory. The routine work would be facilitated, however, by the employment of a person skilled in the isolation and

cultivation of microorganisms, to assist in preparing materials for the chemical investigations.

The use of microorganisms in connection with analytical operations, and for the manufacture of various substances in the laboratory and in the factory, is a field promising rich rewards to diligent investigators and one that has hitherto been but comparatively little worked. A beginning was made in the Division of Chemistry eight years ago, when investigations relative to the organisms of nitrification and denitrification were begun. The funds available have never permitted a vigorous prosecution of these important investigations. It is believed, however, that the appropriation of the present year will permit the preparation of the material at hand for publication and a renewal of the laboratory investigations. An item is inserted in the estimates for the collaborative work with other Departments, in ascertaining the quality of goods to be purchased, and also for the investigation of the microorganisms in soils and fertilizers of interest to agriculture.

NEW WORK.

Through the liberality of Congress provision has been made for the inauguration of two very important additional lines of investigation in the Bureau of Chemistry during the current year. The first of these is the experimental study of the effect of preservatives, coloring matters, and other substances added to foods, upon the health of the consumer. To this end direct experiments will be made to determine the influence which these bodies have upon the metabolic changes which food undergoes when ingested into the human organism and which the organism itself suffers. In this connection, series of experiments will be conducted in which ordinary foods, containing none of the substances under study, will be fed under careful chemical supervision, the digestibility of the food determined, and the gain or loss in the body ascertained. The same foods will then be fed in connection with preservatives and coloring matters and other added bodies, and a similar series of observations secured.

The importance of this work is at once evident. There are certain bodies which are uniformly employed as preservatives, which are commonly supposed to be wholesome, perhaps on account of the universality of their employment. Among these may be mentioned vinegar and salt and wood smoke. Other preservatives have a real food value, such as sugar, and the use of this body as a preservative can not be open to any objection whatever. Still other preservatives have a partial food value and are stimulating. Of this class alcohol is a type. The propriety of using alcohol as a preservative is open to grave question.

The coloring matters are usually divided into mineral, vegetable, and coal-tar colors. There is a universal feeling that mineral coloring matters are objectionable, while vegetable coloring matters are not. Of the coal-tar dyes, some are certainly objectionable and others are considered unobjectionable. The time has come, however, when some authoritative data on all these subjects are imperatively demanded.

It is to be regretted that many of the investigations which have been made on these bodies have been, to a certain extent, ex parte. As an instance of this, it may be said that manufacturers of certain products added to foods employ experts to study the effect of these bodies upon metabolism. It is not intended to throw any doubt upon

the ability and honesty of these experts, and yet it is only human that we should assume that in cases of doubt the benefit is universally given to the employer. Again, it may be said that in certain investigations which have been made in regard to the effect of borax, there is room for suspicion that bias has not been entirely absent. It is believed that in the investigations which are contemplated in this Bureau it will be possible to eliminate the element of bias, in so far as human nature is capable of so doing, and to conduct the examination in such a way as to reach conclusions which are not influenced in any manner, neither by the person manufacturing the products, the desire of the person consuming them, nor the purpose of the chemist conducting the work. While it is not claimed that the results obtained in such a way are absolutely free of error or not subject to revision, it is claimed that they will rest upon a basis which, at least, will not be open to criticism. These experiments, in order to have convincing results, must be made with care, must be repeated frequently, and the data obtained must be carefully studied and collated. It is expected that this work will be thoroughly inaugurated before the end of the current year.

The second line of work which the Bureau will undertake will be in the study of drugs. The object of this study is to determine the composition of the drugs sold upon our markets and of the adulteration to which they are subject. Drugs which fail to come up to the standard set by the United States Pharmacopœia or drugs of a poisonous nature which have a higher percentage of the poisonous principle than is recognized by established authorities must be considered as adulterations. Drugs in order to be efficacious must have a certain composition; otherwise, in the exhibition of remedies, neither the physician, the pharmacist, nor the patient has any idea of the quantity of the active principle employed.

This work will be undertaken in hearty collaboration with the American Pharmaceutical Association, which already has a committee studying drug adulterations and the best methods of ascertaining them. The work will be divided into two portions—first, a study of the best methods of assaying drugs, and second, a study of the drug products bought in the open market, to determine their composition and the degree and extent of their adulteration. It is expected that this work will be fully inaugurated during the present year.

CLERICAL WORK.

A large increase in the amount of clerical work necessary in the Bureau has naturally resulted from the enlargement and extension of the scientific work. Although during the present year a stenographer has been added to the clerical force, it is still entirely inadequate to handle the work necessary to keep the records of the Bureau up to date and to do the calculating and other work required in connection with the publication of the bulletins of the Bureau. The mass of correspondence, together with the regular routine work, keeps the clerical force occupied to its fullest capacity, and it necessarily follows that much of the work in connection with the permanent records of the Bureau is in arrears. As in the other Bureaus, the services of a chief clerk are necessary, and I have included an item for this purpose in the estimates submitted.

REPORT OF THE CHIEF OF THE BUREAU OF SOILS.

U. S. Department of Agriculture,
Bureau of Soils,
Washington, D. C., September 20, 1902.

Sir: I have the honor to transmit herewith a report upon the work of the Bureau of Soils for the fiscal year ended June 30, 1902.

Respectfully,

Milton Whitney,
Chief of Bureau.

Hon. James Wilson, *Secretary.*

WORK OF THE YEAR, WITH RECOMMENDATIONS.

Organization.

The organization and work of the Bureau of Soils have been along essentially the same lines as heretofore, with the addition of an important line of work in the division of soil management. Attention has been given, as heretofore, to the administrative work, the soil survey, the tobacco investigations, drainage investigations, and the laboratories maintained in support of these several lines of field work. The wisdom of Congressional action in converting the Division into a Bureau and largely increasing the appropriation has been shown in the amount of work done and in the cordial appreciation of this work from various sources. The soil survey, particularly, has been greatly extended, and the division of soil management, although merely started during the year, gives promise of some more important results than have been achieved in soil investigations for some time past. Prof. Franklin H. King, formerly professor of agricultural physics at the University of Wisconsin, has taken charge of this line of field work. He is considered peculiarly fitted for this place, and his appointment has been very generally commended.

During the year Mr. M. L. Floyd, the tobacco expert who had done so much to make successful the tobacco investigations of the Bureau, severed his connection with the Department to become general manager of a tobacco corporation organized to grow the shaded Sumatra tobacco in Connecticut, an industry established by this Department. In his new position, Mr. Floyd receives far greater remuneration for his services than the Department could afford to pay, in view of the salaries paid to others by the Government.

The interest in the work of the Bureau of Soils is growing rapidly, and the demands for work in different parts of the country are increasing, as evidenced by the liberality of Congress in enlarging the appropriation and by the many requests received for the extension of the different lines of investigations. The Bureau of Soils now has a force

of over 100 persons, 75 of whom have had a scientific training. It is believed that the results of the work in showing the conditions and resources of the soils of the country and in giving the people precise and accurate knowledge as to the possibilities of the soils justify fully every expenditure that has been made and every recommendation that will be made for the further extension of the work. With the fierce competition for commercial supremacy now going on, every particle of information bearing upon the natural resources of the country which will in any way tend to increase the production of our present crops or to develop new methods or build up new industries is of the utmost value, especially if, as in this case, the people are inspired with sufficient confidence to heed the advice of the Department and to take advantage of its work.

Cooperation with State Institutions.

During the year this Bureau has cooperated, as far as possible, with State institutions, including experiment stations, boards of agriculture, and geological surveys; also with Bureaus and Divisions of this Department, as well as with other Departments of the Government. Such cooperation has been particularly close with the North Carolina department of agriculture and with the Illinois experiment station, both of which institutions have contributed money toward the expenses of the soil survey in their respective States. In other States the cooperation has been just as cordial, but the institutions have not been able to render financial assistance. Their advice has been sought and given wherever possible in arranging for and in the carrying on of the work, and the work has been done, as far as possible, with the ultimate object of being of service to the State institutions in the prosecution of further and more detailed work. The Utah experiment station has cooperated in the line of drainage investigations and has contributed valuable assistance and advice in the work that has been started at Salt Lake City. The Connecticut experiment station and the Pennsylvania experiment station have continued their cooperation in the tobacco investigations with credit and profit to all of the institutions concerned.

The Bureau of Soils, through its laboratories, its soil survey, and its other lines of investigation, has cooperated with and has helped other Bureaus and Divisions in the Department, and has cooperated with the War Department in furnishing an assistant to organize a soil survey in the Philippine Islands, and in furnishing assistants to inspect the soils of some of the military posts and to advise as to the treatment in the establishment of parade grounds, a matter which is of considerable importance, involving the expenditure of large sums of money where the natural soils are not suited to the formation of a permanent sod.

Progress and Cost of the Soil Survey.

The area surveyed and mapped during the fiscal year was 14,541 square miles, or 9,306,240 acres, and the area previously reported as having been surveyed was 8,082 square miles, making a total of 22,623 square miles, or 14,478,720 acres. This work was carried on during the year in twenty-five States and Territories and in Porto Rico.

The table on the next page shows the total area surveyed during the fiscal year 1902, together with that previously reported, in each of the

thirty States and Territories in which the soil survey work has been carried on. This work has been uniformly done on a scale of 1 inch to the mile, and the maps have been published or are ready for publication. This table does not include any areas in which work of reconnoissance merely has been done, but only areas in which actual soil surveys have been made and soil maps prepared.



Areas covered by the soil survey to June 30, 1902.

Areas surveyed and mapped during fiscal year ended June 30, 1902, and the areas previously reported.

State or Territory.	Work during 1902.	Work previously reported.	Total.	
	Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Acres.*
Arizona	95	400	495	316,800
California	753	1,401	2,154	1,378,560
Colorado	150		150	96,000
Connecticut		245	245	156,800
Georgia	571		571	365,440
Idaho	399		399	255,360
Illinois	1,359		1,359	869,760
Iowa	432		432	276,480
Kansas	461		461	295,040
Kentucky	330		330	211,200
Louisiana	202		202	129,280
Maryland	418	1,762	2,180	1,395,200
Massachusetts		155	155	99,200
Michigan	828		828	529,920
Mississippi	666		666	426,240
Missouri	168		168	107,520
Montana	105		105	67,200
New Jersey	908		908	581,120
New Mexico		100	100	64,000
New York	490		490	313,600
North Carolina	1,625	1,800	3,425	2,192,000
Ohio	500	480	980	627,200
Pennsylvania	519	420	939	600,960
Porto Rico	330		330	211,200
South Carolina	686		686	439,040
Tennessee	547		547	350,080
Texas	495		495	316,800
Utah		768	768	491,520
Virginia	1,354	250	1,604	1,026,560
Washington	150	301	451	288,640
Total	14,541	8,082	22,623	14,478,720

The following table shows the area surveyed and mapped and the cost of the work during the fiscal year ended June 30, 1902:

Areas surveyed and mapped and cost of the field work during fiscal year ended June 30, 1902.[a]

State or Territory.	District.	Area surveyed.	Cost per square mile.	Total cost.
		Sq. miles.	*Dollars.*	*Dollars.*
Arizona	Yuma area	95	4.61	437.95
California	Imperial area	169	3.17	535.73
Do	Salinas Valley	344	3.42	1,176.48
Do	Ventura area	240	3.77	904.80
Colorado	Rockyford area	150	4.73	709.50
Georgia	Cobb County	346	1.44	498.24
Do	Covington area	225	.71	159.75
Idaho	Boise area	399	1.81	722.19
Illinois	Clinton County	494	.88	[b]434.72
Do	St. Clair County	215	1.15	[b]247.25
Do	Tazewell County	650	1.39	[b]903.50
Iowa	Dubuque area	432	.94	406.08
Kansas	Wichita area	461	1.94	894.34
Kentucky	Union County	330	2.20	726.00
Louisiana	Lake Charles area	202	3.71	749.42
Maryland	Harford County	418	1.48	618.64
Michigan	Allegan County	828	1.44	1,192.32
Mississippi	Yazoo area	656	2.24	1,489.96
Missouri	Howell County	168	1.14	191.52
Montana	Billings area	105	4.96	520.80
New Jersey	Salem area	493	1.42	700.06
Do	Trenton area	415	2.23	925.45
New York	Westfield area	260	2.89	751.40
Do	Elmira area	230	2.03	466.90
North Carolina	Alamance County	365	1.32	[c]482.80
Do	Carey area	63	3.11	[c]195.93
Do	Craven area	697	.96	[c]669.12
Do	Hickory area	500	1.01	[c]505.00
Ohio	Columbus area	338	1.34	452.92
Do	Toledo area	162	.95	153.90
Pennsylvania	Lebanon area	[d]519	1.48	768.12
Porto Rico	Arecibo to Ponce	330	5.02	[e]1,655.55
South Carolina	Abbeville area	686	1.01	692.86
Tennessee	Montgomery County	547	1.68	918.96
Texas	Alvin area	280	2.45	686.00
Do	Willis area	215	2.70	580.50
Virginia	Bedford area	[d]382	2.11	806.02
Do	Harrisonburg area	542	1.44	780.48
Do	Prince Edward area	430	1.32	567.60
Washington	Walla Walla area	150	1.82	273.00
		14,541	1.83	26,551.76

[a] This includes the salaries of the men while in the area and their subsistence expenses, but not the cost of transportation to and from the area.
[b] Of these amounts, $624.95 was spent by the Illinois experiment station.
[c] Of these amounts, $914.20 was paid by North Carolina department of agriculture.
[d] The portions of these areas surveyed in the previous fiscal year were given in the last report.
[e] Of this amount, $300 was paid by the Porto Rico experiment station.

RECAPITULATION.

Cost of field work		$26,551.76
Supplies		858.84
Railroad transportation		2,766.28
Preparation of reports		12,870.17
Total cost of soil survey		43,047.05
Paid by State organizations		1,839.15
Paid by Department of Agriculture		41,207.90
Area surveyed	square miles	14,541
Cost of work in field	per square mile	$1.83
Preparation of reports	do	.88
Transportation and supplies	do	.25
Average cost	do	2.96
Average cost to Department of Agriculture	do	2.81

It will be noticed that the cost of the work per square mile varies from 71 cents in the Covington area, Georgia, to $5.02 for the work in Porto Rico. The average cost has been $1.83 per square mile, as against $2 per square mile during the preceding fiscal year. The area cov-

ered is over two and one-half times as large, and the work has cost 17 cents per square mile less than last year. The variation in the cost per square mile is due in part to the character of the country, the condition of the roads and of the weather, the complexity of the soils, the presence and character of alkali in the Western areas, and the accuracy of the base maps used. The average cost to the Department of Agriculture of the work complete, including supplies and railroad transportation, the preparation of reports, and the salaries of the men during the three winter months, when the field work has practically to be suspended, has been $2.81 per square mile, as against $3.26 per square mile last year, a saving of 45 cents per square mile. This saving is due, not only to the greater efficiency of the field parties by reason of their better training, but also to the longer average length of the field season for each party, which has been accomplished by moving the parties from place to place as the season advances. It has been found possible to keep some of the parties out during the winter in Arizona and southern California, and to shift parties working in the Northern States during the summer months to the Southern States during the fall. In this way the average length of the field season has been something over nine months per party, and it is believed that this can be considerably increased, although it is advisable to have each party spend some time at headquarters, not only for the final revision of their reports and maps, but to get acquainted with the office and laboratory work and to keep in close touch with the objects and purpose of the soil survey.

THE FIELD FORCE.

The organization of the field force has been carried to a very high state of efficiency. Administratively, the very greatest of care and attention to details is given, and the low cost per square mile shown in the preceding statements is due in a large measure to the judicious and economical management of the force. The salaries of the soil experts employed by the Bureau are low as compared with those paid in other branches of scientific work. The expense of a party of two men in the field for subsistence and the hire of a team averages about $120 per month, or $1,080 for the field season of nine months. The parties are equipped with the most modern instruments for the classification and survey of soils, and it has been possible to furnish them with such explicit instructions as to the character of their work, the subjects they are to investigate, and the subjects which are to be discussed in their reports upon areas that they know exactly what is to be done on entering a given area and can proceed with their work with the minimum of time for preliminary investigations or reconnoissances. They are required to report to the central office at least once each week, noting the area surveyed, the new soil types established, and the character of their work; and to send in from time to time sections of their map for criticism and suggestion as the work proceeds. It is required that each party shall complete the map in all details and write up the report in final shape before leaving the area. The report is then typewritten, and a copy returned to the field party for correction or for additions or changes. The work of each party is thoroughly inspected, so far as this has been possible, in order to correlate the new soil types with those already established and to confer with the men as to suggestions which can be safely made of new methods of cultivation or of new industries which may be established. As the work of the soil survey assumes greater proportions, this inspection work becomes more and more

necessary and more valuable, and it is advisable that a regular inspection force should be established for the several districts into which the country may be divided.

The scale upon which the soil maps are published enables tracts as small as 10 acres to be represented, and while there must always be some variation allowed in each type, as it would be confusing to show too much detail on the maps, still, where a type is represented by even a small tract of 8 or 10 acres, it is shown upon the soil map, so that land owners may rely upon an accurate classification of their soils according to the types established.

The reports describe in all necessary detail the characteristics of the soils and their important variations; the history of the settlement and agricultural development of the area; the climate, physiography, and geology; the agricultural methods in use and the agricultural conditions in the area, such as the tenure and size of the farms, the efficiency of labor, the principal products, and transportation and market facilities; together with such special problems as may be encountered, such as hardpan, acidity, irrigation, seepage waters and drainage, alkali, and the reclamation of swamp or worn-out lands or alkali soils, as these all have their bearing upon the commercial use and value of the soils.

THE DEPARTMENT AND THE EXPERIMENT STATIONS IN THE SOIL SURVEY WORK.

With the increasing interest in the soil investigations and the economic value which the results have shown in a number of cases, the experiment stations are taking a lively interest in this work, and it seems proper to mention the true relation which should be established between them and the Department in the further prosecution of the work. It seems advisable that the management of the soil survey should be vested in the Department of Agriculture. This insures continuity in the work and uniform classification of soils; also the benefit of experience in other localities in advising as to the commercial possibilities and value of the introduction of new methods of culture and of new crops and industries. It is advisable that the experiment stations and other State institutions should cooperate in this work to the extent of furnishing assistants or financial aid, as this insures an intimate knowledge of the conditions of the area to the State organization, as well as a larger amount of work within the borders of the State. In many cases, if such financial assistance be given, one or more parties can be assigned for continuous work in a State where, if the expenses were all borne by the Bureau of Soils, a party could be assigned for only a portion of the season. Various State organizations have contributed $1,839.15 toward the field expenses of the soil survey during the past year.

These soil surveys are in the nature of a general reconnoissance of the area. They show the conditions which prevail, and the maps show the character and distribution of the soils. This is, however, merely a basis for further work, and it is necessary in many cases that the information thus furnished and the suggestions which are made should be followed by further investigations and practical demonstrations of the efficiency and commercial value of the suggestions in order to insure their successful adoption by the residents of the area. Farmers are proverbially ultraconservative as to their methods, and are usually and often justifiably very unwilling to accept advice unless it can be shown that improvement will surely follow. Such demonstration work can, in most cases, be better accom-

plished by the stations than by the Department of Agriculture, for the station forces have a more intimate knowledge of the conditions and of the people, and are, as a rule, in closer touch with the people than is the Department, and with these reports and maps they have the basis for further work in the improvement of the agricultural conditions of the area, upon which they can expend their full energy and all the resources at their command. If the soil survey work is not followed up on these practical lines much of the efficiency and value of the work will surely be lost.

As pointed out in my last report, the experience of the men engaged in this work is likely to be invaluable, not only to them, but to the country as well. Spending, as they do, from three to nine months in an area, making a critical study of the soils, crops, methods of cultivation, and market and transportation facilities, and bringing together this experience from all sections, the men have unusual opportunities for securing a wide knowledge of the agricultural industry of the country and its resources. This is training up a class of men fitted to observe and appreciate resources and advantages that should be of immense value in the further development of the agricultural interests of the United States as the country becomes more thickly settled and the strife for commercial supremacy becomes greater. As these men become riper in experience and judgment and have a fuller knowledge of the agriculture of the country, they will doubtless be called to positions of trust and responsibility in State organizations and in commercial enterprises in which their experience and ability will be invaluable. This is and should be one of the important functions of the Department, and the influence of the Department will be felt more and more throughout the country as these men are called to such positions.

PAST AND PROPOSED WORK OF THE BUREAU OF SOILS.

The statements following show the results that have been accomplished during the past year and the work that is proposed during the present and the next fiscal year in each of the States. This is, of course, subject to change as to details as the time approaches for the actual prosecution of the work. It is given as the basis for the continuation and extension of the work.

ALABAMA.

No work has been done in this State during the past fiscal year, but it is proposed this fall to make a soil survey of Perry County, which lies partly in the black calcareous prairie belt and partly in the sand region. Two parties will be assigned to this area in October, with the expectation that the whole of the county can be surveyed during the present field season. On the completion of this work, both parties will be transferred to Mobile County to make a soil survey of that area, particularly in the interest of the truck growers, and to investigate the adaptation of the soils to tobacco. After this it is contemplated to make a soil survey in Marshall County in the interest of the fruit and tobacco growers and to survey Lauderdale County, if possible. In all, it would be advisable to spend nine months in Alabama during the next field season.

ARIZONA.

During the past field season a soil survey was made of the area below Yuma, where the waters of the Colorado River are taken out for irrigation. The whole area covers about 95 square miles, although

only a portion of it is at present under ditch. A considerable part of this area is subject to overflow during flood times in the Colorado River, and schemes have been proposed for dikes and levees to prevent this overflow, which, if carried out, will add a considerable area of valuable land to the irrigated district. This tract, with its tropical climate and fertile soils, has been compared to the delta of the Nile, and it is the intention of the Department, through its soil survey and through the work of the Bureau of Plant Industry, to see if crops equally as valuable as those cultivated along the Nile and adapted to this tropical climate can not be introduced.

This party was in charge of Mr. J. Garnett Holmes, who has had considerable experience in soil survey work in other parts of Arizona and in southern California.

It is believed that the information obtained in this work will be the basis of most valuable economic development in the introduction of crops from Algeria and Egypt. There is quite a variety of soils of different character in this area, and while there is considerable trouble with alkali, it is believed that this problem can be easily controlled, and that the locality will develop into one of the important irrigated districts of the West.

It seems advisable to spend three months in a soil survey of the upper Gila Valley around Solomonville during the next field season.

ARKANSAS.

No soil surveys have been made in this State during the past fiscal year, but a party is at present in the State, making a survey around Stuttgart. It is impossible at this time to make any statement as to the economic results of this work.

CALIFORNIA.

Soil surveys have been carried on in three areas during the fiscal year, namely, around Imperial in the Colorado Desert, in the Salinas Valley, and in the Ventura area.

The work in the Salinas Valley was undertaken particularly in the interest of the sugar-beet growers. This was formerly a great wheat area, but in recent years the yield of wheat has fallen almost below the point of profitable production and barley has taken its place to a considerable extent. The rainfall, however, is so variable that crops are uncertain without irrigation, and irrigation systems are now being planned, particularly for the sugar-beet industry, which has developed to large proportions.

This party was in charge of Mr. Macy H. Lapham, and the area surveyed covered 344 square miles. Eleven different types of soils were recognized and their relation to the various crops determined. The relation of these soils to crops had been recognized to a certain extent, but the orderly classification of the soils can not fail to be of value in the future development of the agriculture of the area, especially as the industry is at present changing and developing along new lines.

All of the soils capable of cultivation in Ventura County were surveyed by a party under the charge of Mr. Holmes, the area aggregating 240 square miles. There are several valleys where irrigation is practiced, the most extensive being the valley of the Santa Clara River. Over a large part of the area, however, crops are grown without irrigation, the principal crops being lima beans, sugar beets, and barley.

The soils of the upper part of the Santa Clara Valley are generally well drained and free from alkali. Extensive areas of the delta lands, including some of the most fertile soils of the county, are deficient in drainage, and the alkali problem is becoming more and more serious. As a result of the survey, and from experiments that have been made at the suggestion of the Bureau, it is evident that the alkali problem can be economically and efficiently controlled. Thirteen types of soils were recognized in this area, and their relation to crops reported upon.

From the results attained in the irrigation of the area below Yuma, and from the exceedingly arid climate, it was believed that the Colorado Desert afforded exceptional facilities for the introduction of certain tropical plants, as well as for Egyptian cotton and other products successfully grown in Egypt and on the Algerian Desert. In furtherance of this idea, a company was organized under the laws of Mexico to construct a canal through Mexican territory and deliver water from the Colorado River to a point near Calexico, on the border line between this country and Mexico, to a company chartered under the laws of the United States to distribute the water to settlers in the Colorado Desert. The land was taken up under the homestead and desert-land laws and water rights purchased from this company for the irrigation of the lands. It was realized that it was very desirable, as this enterprise was starting, to make a soil survey in order to classify the soils and determine their alkali content and their relation to crops. Accordingly, Messrs. Means and Holmes were assigned to this work and an area of 169 square miles was surveyed around Calexico and Imperial.

This country lies at or somewhat below sea level, the Salton Sink, the lowest portion of the desert, being about 270 feet below sea level. Five distinct types of soil were recognized in this area, ranging from a loose, incoherent dune sand to a very impervious clay, and including a sand, a sandy loam, and a loam. The area is everywhere underlain with a stiff, impervious clay containing alkali. The Imperial clay is difficult to cultivate, and water penetrates it very slowly. Large areas of alkali lands were encountered, and it is estimated that about 54 per cent of the area has more than 0.4 per cent alkali as an average for 6 feet in depth. There are serious problems, therefore, to be encountered in the successful development of agriculture in the area. It is believed that about 50 per cent of the area can at present be cultivated in nearly all crops adapted to the locality, while a considerable portion of the remainder may be reclaimed by drainage, or can be used for alkali-resistant crops.

The importance and necessity of having this knowledge of the soil conditions has been recognized, and very urgent requests have been received for an extension of the soil survey work to embrace practically all of the lands in the Colorado Desert which can be irrigated, as a basis for the intelligent cultivation of this area, and to insure, as far as possible, the successful settlement of the country. Recognizing the importance of this work, it is proposed to combine a number of our field parties and place them in the area during the coming fall and winter to make a soil survey of about 1,500 square miles of the Colorado Desert, so that settlers may know the actual character of the soils which they purchase, and that industries can be established on the soils best adapted to them.

In addition to this work, it is proposed to extend the soil survey to the Santa Clara Valley in the interest of sugar-beet, grain, and stock production, and to take up the San Bernardino Valley in south-

ern California, which is the last of the great fruit areas in southern California that remains to be surveyed. It is believed that very valuable results will be attained by the soil survey when it is extended to the sugar-beet area around Chino and the fruit areas of Pomona, Riverside, San Bernardino, and neighboring towns.

In all it appears desirable to spend twenty-one months, on the basis of one party, in the State of California during the next field season, and it is believed that the importance of the areas to be investigated fully justifies the time and attention to be given to the work.

COLORADO.

During the present field season a soil survey is being made, under the charge of Mr. Macy H. Lapham, of the irrigable lands of the Arkansas Valley between Rockyford and the Kansas State line. There will be nearly 1,000 square miles of intricate soil mapping, with alkali problems to be worked out, but it is believed that by concentrating some of the northern parties in this area during the fall the whole area can be surveyed. This work is undertaken principally in the interest of the sugar-beet growers and of the melon and truck growers. Not only is it desirable to understand better the relation of the soils to crops, but with the extension of irrigation systems the natural drainage is found to be deficient and alkali is rising and threatening trouble and losses. The work has progressed far enough to indicate that the alkali problem can be economically and efficiently controlled, and it is believed that the classification of the soils will give a basis for the most profitable development of the sugar-beet and truck interests of the area.

It appears desirable to spend about six months during the next field season in a survey of the San Luis Valley, where the alkali problem is becoming far more serious even than in the Arkansas Valley.

CONNECTICUT.

No extension of the soil survey has been made in the Connecticut Valley since 1899, but with the extension of the profitable industry of producing the shade-grown Sumatra tobacco there is a very strong demand now that the survey should be extended to include many smaller valleys on either side of the area surveyed in 1899, and it is proposed to spend about three months in the State during the next field season, to give a basis for the extension of the tobacco industry on either side of the main valley.

DELAWARE.

No surveys have been made as yet in Delaware, and none are contemplated during the present year. There is, however, a demand for a soil survey to extend over the entire State, and it seems desirable to spend three months in the State during the next fiscal year in such work.

FLORIDA.

No surveys have been made in this State up to the present time, but it is proposed, if suitable arrangements can be made for a base map, to make a soil survey in Gadsen County in the interest of the tobacco growers.

GEORGIA.

During the past fiscal year two areas were surveyed in Georgia, including Cobb County and an area around Covington, the former

being under the charge of Mr. R. T. Avon Burke and the latter of Mr. Herbert W. Marean.

It was hoped that the survey in Cobb County would show the possibilities of fruit raising, but it is believed that the prospects for this industry are not so favorable in this locality as they are farther north, and it is therefore proposed to extend the survey to include the northern half of the Ellijay sheet of the U. S. Geological Survey to include portions of Union, Gilmer, and Fannin counties, in the interest of the fruit growers and as an extension of the survey in the mountain areas in Virginia and North Carolina. It is intended to give about six months to this work during the next field season, and it is also proposed to survey an area in Decatur County in the interest of the tobacco growers.

HAWAII.

No soil survey has been made in this Territory as yet, but there have been strong demands for the work, and a recommendation will be made for needed legislation to permit the Department to extend its soil survey work to that Territory at an early date.

IDAHO.

A soil survey party, under the direction of Mr. C. A. Jensen, has completed a survey of the Boise area, extending from Boise City to a point some distance west of Caldwell and including the principal irrigated lands of that section. Serious problems were encountered in this area in the occurrence of hardpan in the soils, and there were other soil problems upon which advice was given which it is believed will be of material economic value in the agricultural development of the area, which is assuming considerable importance.

A party, in charge of Mr. Louis Mesmer, has been assigned to survey the area between Lewiston and Moscow. The wheat yields in this area have declined, and the people are anxious to introduce forage crops, and the soil survey work is to be used as a basis for the consideration of this problem.

Representations have been made to the Department which make it appear advisable to spend about six months in the next field season in the survey of the irrigated lands of the Blackfoot area.

ILLINOIS.

Through cooperation with the Illinois experiment station the Bureau was enabled to put two parties in the field during the early part of the present field season, and at the close of the fiscal year had made a soil survey of Tazewell and Clinton counties, under the direction of Mr. Jay A. Bonsteel, and a portion of St. Clair County, under the direction of Mr. George N. Coffey. During the remainder of the present field season it is proposed to finish St. Clair and Clay counties, if time permits. So far as this work has been examined, particularly the finished maps of Tazewell and Clinton counties, it is believed that the results will be of material benefit and value to the farmers. Thirteen soil types were recognized in Tazewell County and seven in Clinton County and their relation to crops reported upon.

A copy of the soil map and report on the Tazewell area has been sent to one of the most intelligent and progressive land owners, with the request that the work be critically examined and freely criticised, so that we may get advice in advance of publication as to the practical

utility and usefulness of the work and suggestions as to other lines that could be profitably developed.

So far as the Bureau is at present informed this work has aroused a great deal of interest, and it is believed that it will be of value to the people. Requests have been made for upward of 25,000 copies of each of these reports, with accompanying maps, to supply the local demand which is likely to arise. So much interest has been taken in this survey that urgent requests have been made by the Illinois experiment station that the work shall be continued in the State, and it is proposed to assign a party to the State for the entire field season of nine months during the coming year. It is understood that the station will continue its cooperation, and possibly arrangements can be made for more than one party, so that the work may progress rapidly.

One of the most serious problems encountered in the soil survey, particularly in Clinton County, is in the hardpan, or the compact nature of the underlying clay subsoil, in some of the soil types. This not only renders cultivation difficult, but makes crops uncertain under certain climatic conditions, and an investigation of the cause of this and a possible remedy is now engaging the attention of the laboratories of the Bureau.

INDIANA.

No work was carried on in this State during the past fiscal year, but a party is at present engaged in making a soil survey of Posey County. This is in charge of Mr. Marean, and the whole area of the county is to be surveyed. This is particularly in the interest of the truck growers, as large quantities of watermelons and other truck crops are produced on some of the sandy soils of the area.

While there has been some demand for the extension of this work to include the whole area of the State, the plans at present contemplate a survey of only three months' duration in Boone County during the next field season.

IOWA.

During the past fiscal year a soil survey has been made around Dubuque, under the charge of Mr. E. O. Fippin. Eight soil types have been recognized and their relations to crops reported upon.

Rather strong demands have come for the continuation and extension of this work to include the entire State, but it is proposed to spend but six months during the next field season in surveying a part of Cerro Gordo and Story counties in the interest of sugar-beet production, as well as of general farming, stock raising, and dairying.

KANSAS.

During the past field season 461 square miles have been surveyed around Wichita. It was expected that this would be a very uniform area, but nine soil types were encountered, each with distinct properties and adapted more or less to different crops or requiring different methods of cultivation. The possibilities are shown of some degree of specialization of crops and the introduction of fruit interests to take the place of the almost universal crops of wheat and corn, which it is believed will be of value in the further development of the agricultural interests of the area. This work has been in charge of Mr. J. E. Lapham.

It seems desirable to spend about six months in the survey of a portion of the Parsons sheet of the Geological Survey, in the north-central part of the State, in what may be considered the beginning of the semiarid portion of the West.

KENTUCKY.

During the past fiscal year a survey was made of Union County, which has an area of about 330 square miles, under the charge of Mr. Marean. Eight types of soil were recognized, and while apparently the soils are quite uniform in texture and natural fertility, the possibilities of introducing new industries and better methods of cultivation were clearly indicated. At present the area is given up almost exclusively to wheat culture, but there are good opportunities for greater diversification through improvements in the management of soils, the rotation of crops, and in growing products new to the area.

Demands for soil survey work in Kentucky have been quite strong, and it seems desirable to assign a party to that State for nine months during the next field season, the surveys to include Henderson, Christian, and Scott counties. This work will be mainly in the interest of the tobacco growers, stock raisers, and general agricultural interests.

LOUISIANA.

A soil survey was made during the last fiscal year by Mr. W. H. Heileman in the Lake Charles area in the interest of the rice growers, an area of 202 square miles having been covered. Six types of soil were recognized in what was supposed to be a uniform area, and it was found that the relation of these soils to the yield of rice was quite marked, and the desirability of extending the survey to other rice districts was clearly recognized. Moreover, under the present system of exclusive rice culture, not even sufficient food for the stock is produced, while meat and vegetables for the support of the people are imported in large part from other States. There is no reason for this so far as the soils or climatic conditions are concerned, and it is pointed out that a proper diversity of interests would materially add to the welfare of the community.

It seems desirable to spend three months during the next field season in Arcadia Parish in the interest particularly of the rice, sugar, and tobacco producers.

MARYLAND.

Very strong demands have come for the continuation of the surveys in Maryland to include the whole of the State, and particularly of Worcester, Somerset, and Baltimore counties, and it is proposed to assign a party there for six months during the next field season.

During the past fiscal year Harford County, covering an area of 418 square miles, has been surveyed by a party under the charge of Mr. W. G. Smith. There is no place where the survey has been carried on where more interest has been manifested and more use has been made of the work than in this State. Possibilities have been shown, particularly in Prince George, St. Mary, and Calvert counties, of the specialization of crops in the line of fruit growing, trucking, and general farming and dairying, which would very materially benefit the people and add greatly to the prosperity of the community.

While much work has already been done in this State, it is believed that the intelligent interest and appreciation shown in the results of

the work justify the Department in pushing the surveys and giving the people the information they seem to need, and which they appear ready to benefit by in the practical extension of their agricultural interests and in developing the prosperity of the State.

MASSACHUSETTS.

No work has been done in this State since 1899, and the establishment of the profitable Sumatra tobacco culture has aroused a decided demand for the extension of the survey of 1899 in the Connecticut Valley northward to the State line and on either side of the area which has already been surveyed. It is proposed to spend three months during the next field season in the extension of this work in the interest particularly of the tobacco growers.

MICHIGAN.

During the past fiscal year Allegan County, covering an area of 828 square miles, has been surveyed under the direction of Mr. E. O. Fippin. This work was undertaken particularly in the interest of the fruit growers along the lake shore and of the sugar-beet and general agricultural interests. This appears to be one of the most valuable pieces of work the Bureau has done, and it is believed that the results, which form a part of the report of the field operations for 1901, will be of very great value to the people in the extension of their present industries, the improvement of methods of cultivation, and the development of new crops, which it is believed can successfully be introduced. The experience of the people of this section will also prove of value to other communities, and the lessons taught by the soil survey will, it is believed, have value outside of the area.

No work is contemplated for this State during the next field season, but strong demands have come for an extension of the survey, and it is believed that it should be resumed at the earliest practicable time, particularly in the interest of the sugar-beet and fruit growers.

MINNESOTA.

No work has been done in the State, but strong demands have come for the extension of the soil survey, and it seems desirable to assign a party there for six months during the coming field season, the first area to be surveyed being probably Lyon County.

MISSISSIPPI.

During the past fiscal year the Bureau has mapped an area of 656 square miles around Yazoo City, the work being in charge of Mr. Jay A. Bonsteel.

About one-third of the area is in the uplands and two-thirds in the Yazoo and Mississippi Delta. The upland soil is a typical loess, and it has been suggested, as a result of the survey, that alfalfa can be produced on it as a basis for stock raising. In its present condition it is little esteemed as a cotton soil.

It was supposed that the delta would present a very uniform soil condition, but four soil types were recognized, each with very distinct agricultural values. The Yazoo clay is the most productive cotton soil, yielding from 1½ to 1⅔ bales per acre, and even more under the best methods of cultivation. This, however, only covers about 17

per cent of the delta. The Yazoo loam, covering about 6 per cent of the delta, yields from three-fourths to 1 bale of cotton per acre. The Yazoo sandy loam, covering 9 per cent of the delta, produces about three-fourths of a bale to the acre, while the Sharkey clay, covering 68 per cent of the delta, is not cultivated on account of the annual overflow. The flood waters leave the land about the first of June, but although the land is subsequently dry it is then too late for crops to be put in.

It has been pointed out, as a result of this soil survey, that the Yazoo sandy loam is a typical early truck soil, and that, with the prevailing climatic conditions, potatoes or other truck crops would prove a remarkably profitable industry on this soil.

The Sharkey clay is a wonderfully productive soil, and it appears from the investigations that have been made that the engineering problem of protecting it against the annual floods would not be very difficult, nor expensive when the value of the soil so reclaimed is considered. It is believed that these three suggestions, if followed by the people, will well repay the money expended in the survey.

It is proposed to continue and extend this work to include a larger area of the delta lands and possibly to take up one other area in the State, devoting in all about six months in the next field season to the work.

MISSOURI.

During the latter part of the past fiscal year Mr. Fippin was assigned to survey Howell County, in the fruit area of the Ozark region. It is probable that the whole area of this county will be surveyed during the present field season. It has been found that the soils are remarkably uniform and that the fruit interests can be extensively developed, but it is advisable that the methods be improved to attain the highest commercial success.

The demand for the continuation and extension of this work in Missouri has been so great that it seems desirable to assign a party there for nine months for the survey of Shelby, Saline, and Webster counties during the next field season.

MONTANA.

During the past fiscal year the Billings area, comprising about 105 square miles, has been surveyed under the direction of Mr. C. A. Jensen. Considerable trouble and loss has resulted from the rise of alkali in this area, and the survey was planned with particular reference to determining the possibility of preventing this trouble and reclaiming the land already damaged. It is considered quite feasible to accomplish this object, and it is probable that a demonstration will be made of the efficiency of proper drainage in preventing the rise of alkali and in reclaiming the alkali soils of this locality.

It would seem desirable to assign a party to this State for six months in the next field season to make surveys in the Gallatin Valley and in the Milk River Valley around Glasgow.

NEBRASKA.

No work has heretofore been done in this State, but it is proposed to assign a party for nine months of the next field season to make soil surveys of the Grand Island and Holdrege areas in the interest particularly of the sugar-beet industry.

NEW JERSEY.

During the fiscal year just passed a survey of the Salem area, comprising 493 square miles, was completed under the direction of Mr. Bonsteel, and a survey of the Trenton area, under the charge of Mr. Burke, has been started and will be completed during the present field season.

The Salem area lies wholly within the Costal Plain region and has eleven different types of soil. These are adapted to various truck crops, fruit interests, and general farming. The people have already recognized the relation of the soils to crops, and have adapted their industries to the various soil areas. The success has been so remarkable that the lesson may well be carried to other localities along the At antic coast where similar soils prevail.

The Trenton area lies partly in the Costal Plain and partly in the Piedmont Plateau, and gives even a wider range of soils. This area is particularly adapted to specialization of crops and the building up of widely different agricultural interests.

The interest in this work justifies its continuation, and it seems desirable to spend six months during the next field season in the survey of the Monmouth Shore area, east of and immediately adjoining the Trenton area.

NEW YORK.

During the past fiscal year a soil survey was made of the Westfield area under the direction of Mr. Burke, and of the Elmira or "Big Flats" area under the direction of Mr. Mesmer.

The Chautauqua grape belt, extending for 30 miles along the Lake Erie shore, is within the first-named area. The old beaches, where the grape industry was first developed, have been outlined upon the map, and the Dunkirk clay, upon which the industry has since been developed, is also located, as well as several other foreland and upland soils adapted to general farming and dairying.

The survey of the Elmira area was undertaken particularly in the interest of the tobacco growers, and more especially to see if the cultivation of Sumatra tobacco could be extended there, and to form a basis for other tobacco investigations for the improvement of their present crops. The results indicate that the Sumatra tobacco can not successfully be produced within the area surveyed, except in one small area of not over 10 or 15 acres, where it might be grown. An experiment is in progress to determine this point, although this is not under the control of the Department. The results of the survey point to the need of further investigations of these soils, which under the present methods of cultivation require large annual applications of stable manure to produce satisfactory yields of the crops of the locality. There is an opportunity here for the work of the new division of soil management, which would probably yield results of value to the people.

During the present field season the survey has been extended to the Lyons area in the interest particularly of the sugar-beet growers. It is proposed during the coming field season to detail a party for nine months to make a soil survey of the whole of Long Island. This is particularly in the interest of the truck growers, and it is believed that the results will be of considerable interest and value.

NORTH CAROLINA.

During the past fiscal year a survey has been made of the Alamance County, Cary, and Craven areas under the direction of Mr. Coffey, and of the area around Hickory under the charge of Mr. Caine.

Alamance County is in the Piedmont Plateau, and the work was undertaken in the interest of the cotton growers and general farming. Formerly this was an important bright-tobacco section, but the growth of this industry in the eastern part of the State has been the cause of a decline in tobacco production in the area, and the soils formerly adapted to this special industry have depreciated considerably in value. Various suggestions of a practical nature in the line of improved methods of cultivation and the introduction of new crops and new industries have been made as a result of the soil survey.

The work in the Craven area was carried on particularly in the interest of the truck growers and in order to outline the truck soils in this area, which is not as yet very thickly settled.

The work in the Hickory area was in the interest of general farming and, in the mountainous portion, of fruit growing. It is proposed to extend this work during the present field season to the Mount Mitchell area in the interest of the fruit growers.

There is no more interesting development at the present time in the Atlantic coast States than that of the fruit interests in the mountains of Virginia, North Carolina, Georgia, and Alabama. From the work so far done in these States it is clearly apparent that the soil has an important bearing on the different fruit crops, and the apple and peach soils can be identified and outlined as a basis for the intelligent development of these industries. Not only are certain soils adapted to apples, but certain varieties of apples do better on some soils than on others, and the same is probably true of other fruits.

The North Carolina department of agriculture has cooperated very cordially and very helpfully in this work, and it appears desirable to continue this cooperation, assigning a party there for nine months during the coming field season to extend the soil survey.

NORTH DAKOTA.

Very strong demands have come from this State for the extension of the soil survey to include most of the arable portion of the State. It has been impossible until recently to start the work there, but a party has just been assigned to the Grand Forks area, in the Red River Valley, under the direction of Mr. Jensen, who has had wide experience in similar areas in Utah and Montana.

Considerable quantities of alkali are encountered, but generally at a sufficient depth below the surface to enable the annual crops to be produced. The surface foot is usually free from alkali, and as there is no irrigation, and little chance for irrigation, it is believed that there is little danger of the alkali coming to the surface and spreading. It seems a risky thing, however, to have the valuable crops of the locality growing over and so close to these alkali salts, and the possibility of the rise of this alkali should be fully investigated. If it were in an area where water was available for irrigation, it could safely be predicted that the land would quickly be injured by the rise of alkali, but with no opportunity for irrigation the chances are that conditions may not become more serious than at present. This is a question, however, that these investigations will have to solve. The work is being carried on in cooperation with the State geologist.

It seems desirable to assign a party to this State for six months' work during the next field season.

OHIO.

During the past fiscal year work has been started in the Columbus area and in the Toledo area, and it is believed these will both be completed by the end of the present field season. The surveys are being made under the direction of Mr. W. G. Smith.

The Columbus area is devoted to general farming. While there is a certain uniformity in the soils, one of the principal soils is preeminently a wheat land and another chiefly a corn land, the character of the soils showing very strongly their peculiar agricultural values in the crops produced and in the success of these crops.

It is proposed to assign a party to this State during the next field season to survey a part of Ashtabula County in the interest of the fruit and tobacco growers.

OREGON.

No surveys have been made in this State, but it is proposed to assign a party there for six months during the next field season to survey an area around Salem, in the Willamette Valley.

PENNSYLVANIA.

During the past fiscal year a survey of the Lebanon area, in the interest of tobacco growers and general farming, was completed under the direction of Mr. Smith. The interest taken in the survey around Lancaster leads me to believe that the results of this work will be found of interest and practical value in the still higher development of the agricultural conditions of the locality.

It seems desirable to assign a party for three months during the next field season to make a soil survey of Clinton County, particularly in the interest of the tobacco growers.

PORTO RICO.

During the past fiscal year an area of 330 square miles was surveyed in a strip about 10 miles wide, extending from Arecibo to Ponce, the work being in charge of Messrs. Dorsey and Mesmer. Twenty-two types of soils were recognized, all of them markedly different from the soils encountered in the United States. Much of the country is rugged, broken, and mountainous, and as there were no available maps, the base map had to be made as the soil survey progressed. Many of these soils are not well adapted to agriculture, but the report deals fully with the conditions as they were actually seen, and it is believed that it will form a basis for a more intelligent development of the agriculture of the island.

It is deemed advisable that this survey should be extended to include the whole area of the island, of which about one-tenth is included in the area already surveyed, but under a change made in the wording of the appropriation bill it will be impossible for the Bureau of Soils to continue this work. It will be recommended that such changes be made in the next appropriation act as will enable the Department to resume operations in Porto Rico. I know of no more valuable work the Department can do than to thus investigate the actual conditions in these island possessions, and the extension of

the soil survey to them should give a basis for the best and most economical development of their agricultural resources at a time when so many people are looking to these islands for investments and when the people of the islands themselves need all the help that can be given them.

SOUTH CAROLINA.

During the past fiscal year an area of 686 square miles has been surveyed around Abbeville, and on the completion of this work the party, in charge of Mr. Taylor, will make a survey of Darlington County, particularly in the interest of the bright-tobacco growers and truck growers.

It is proposed to detail a party for nine months during the coming field season to survey an area in Spartanburg, Pickens, and Orangeburg counties, particularly in the interest of the cotton, fruit, and bright-tobacco growers.

SOUTH DAKOTA.

No surveys have been carried on in this State, nor are any contemplated for the present field season. It seems desirable, however, to assign a party for a period of three months during the next field season to start a survey in Brookings County.

TENNESSEE.

During the past fiscal year a survey in the interest of the tobacco growers was made of Montgomery County, embracing an area of 547 square miles, under the direction of Mr. J. E. Lapham. Among the important results of this survey has been the suggestion that one type of soil, which is at present of little agricultural value and which covers a considerable area, is adapted to fruit growing, and it is believed that this interest could be introduced with profit to the community. It was hoped that the survey would be the basis of an investigation of the possibilities of improving the tobacco interests, but the appropriation for the Bureau was not sufficient to enable this to be done.

It is proposed to extend the soil survey to Greene, Cumberland, and Davidson counties, assigning a party to this work for a period of about nine months during the coming field season.

TEXAS.

During the past field season the Willis area of 215 square miles has been surveyed in the interest of the tobacco growers, and a party of tobacco experts has been placed there to investigate the possibility of producing a more desirable filler tobacco.

The Alvin area was also started under the direction of Mr. Bennett, and this and the Brazoria area will probably be completed during the present field season. This is particularly in the interest of the fruit growers around Alvin and of the sugar interests around Brazoria.

It is also proposed to survey an area during the present field season around Vernon, in the Panhandle of Texas, in the interest particularly of the wheat growers and with the view that the results may be useful in the introduction of macaroni wheat.

Representations have been made to the Department which make it appear advisable to assign a party to this State for at least nine

months during the next field season for surveys, particularly in Tyler County, and also around Austin and San Antonio.

UTAH.

The soil survey work of 1899 and 1900 has been discontinued in this State, but it is proposed to assign a party for six months during the next field season to survey the irrigable lands around Utah Lake.

The work around Salt Lake City is being followed up by a drainage investigation, having for its object the reclamation of some of the alkali lands.

VERMONT.

A strong demand is made for the extension of the soil survey in the Connecticut Valley in the interest of the tobacco growers, to see if the cultivation of the Sumatra tobacco can not be extended to that latitude. It is proposed to assign a party for three months during the next field season to extend the soil survey of the Connecticut Valley.

VIRGINIA.

During the last fiscal year the Bedford area and the Prince Edward area have both been completed, and the Harrisonburg area has been begun. All of this work has been under the direction of Mr. C. N. Mooney. It is proposed to finish the Harrisonburg area and the northern part of the Buckingham sheet of the Geological Survey during the present field season, and to assign a party to this State for nine months during the next field season to survey the southern half of the Buckingham sheet and the whole of the Harpers Ferry sheet, as well as an area around Norfolk.

The most important work has been done on the Bedford and Harrisonburg areas. These include portions of the Piedmont Plateau, of the Valley of Virginia, and of the intervening mountain area. The results of the work on the plateau and in the valley are important, but the great interest centers in the survey of the mountain soils, in which the fruit interests are developing. It has been found that the different varieties and types of fruit are best adapted to different soils, and as the survey extends and these soils are being outlined the basis is presented for the most intelligent development of the fruit interests.

The Harpers Ferry area will take in a considerable portion of the valley, as well as of the plateau, and the results of the work should show the reason for the decline in agricultural value of the valley soils, and should suggest means for reviving the agricultural interests of what was once a prosperous community on what was considered the highest type of agricultural land.

The survey around Norfolk will be in the interest of the truck growers.

WASHINGTON.

During the past fiscal year the Walla Walla area, covering about 150 square miles and including practically all of the irrigable lands of that locality, was surveyed under the direction of Mr. Holmes. The work has just been finished and the results can not yet be reported.

WISCONSIN.

No work was done in the past fiscal year in this State, but Mr. Jay A. Bonsteel was assigned on July 1 of the present fiscal year to the

Janesville area to survey the soils around Janesville, Stoughton, and Edgerton. This survey is in the interest of the tobacco growers, and is particularly to see if the Sumatra tobacco is likely to be adapted to this section, and to be a basis for the improvement of the type of tobacco at present grown.

It seems desirable to assign a party to this State for six months during the next field season to make a survey, particularly of Eau Claire County.

WYOMING.

No soil surveys have as yet been made in this State, but it is proposed to assign a party for six months during the next field season to survey the soils of the irrigable part of the Laramie sheet of the Geological Survey.

ESTIMATED COST OF PROPOSED SOIL SURVEY WORK.

During the fiscal year 1902 about $40,000 was spent on the soil survey with 10 survey parties. For the fiscal year 1903 an allotment of $60,000 has been made for this work with 15 soil survey parties. For the fiscal year 1904, for which estimates are being submitted to Congress, on the basis of the plans which have just been given for the continuation and extension of the work in order to meet the most urgent demands, an allotment of $120,000 would be necessary. This is based upon a total estimate of 243 months of field work contemplated by the above plans, which will require for its completion within the fiscal year 30 field parties, costing approximately $4,000 each, calculated on the basis of the work done during the last three years. Each party would survey about 1,200 square miles, making a total estimated area of 34,800 square miles, or 22,272,000 acres, in 38 States and Territories, which would be surveyed in that year.

PUBLICATION OF THE REPORT AND MAPS.

The results of the field work of the Bureau of Soils are published under authority of a joint resolution of Congress, approved February 23, 1901, which provides for the printing annually of the Report of Field Operations of the Division of Soils, Department of Agriculture.

The publication of this report exclusively in its present form and at one time, in spite of the fact that it is made up of numerous separate reports presented at various times throughout the year, is undesirable for many reasons. Work that is finished in the winter or spring has to be held in the office until the succeeding February, when the report of the field work is fully completed and sent to the Public Printer. This delays the publication for nearly eighteen months after the work is completed, and the public interests require that publication of each report should follow as soon as possible after the completion of the field work. Furthermore, the publication of all the reports and maps in a single volume makes a bulky and expensive book to send to any person requesting information about a particular area. The demand also is so great that, although the Department has 8,000 copies of the bound report to distribute and the Senate and House of Representatives have together 9,000 copies, the Department received upward of 2,000 requests for the 1900 report which could not be filled. Reprints were ordered of all of the reports, in editions ranging from 500 to 1,500 copies, and these were quickly exhausted. As the work becomes bet-

ter known, many requests are coming from Senators and Representatives, and the opinion is freely expressed that the full value of the work can not be secured unless there is a liberal provision for its distribution within the area in which the work has been done. The requests for reprints of the 1901 report indicate that from 3,000 to 10,000 copies will be required to satisfy the demand, notwithstanding the fact that some of the States are ordering reprints of the maps of the areas in their respective States for their own distribution.

In view of these facts, it is recommended that the joint resolution be so amended as to permit of the Report of the Field Operations of the Bureau of Soils being published in parts or volumes as the work is completed. That there should also be reprinted of the separate reports, with their accompanying illustrations and soil maps, editions sufficient to allow 500 for each Senator to whose State the survey relates, 2,000 for each Representative in whose district the survey may be made, and 1,000 for the use of the Department of Agriculture. This will insure the prompt publication of the results of the survey and a distribution through Members of Congress, which my present information seems to indicate is desirable if the full value of the soil survey work is to be attained in the dissemination of the information thus gathered, promptly and freely, to the people who are interested.

Needed Legislation for Insular Surveys.

It seems desirable that the benefits derived from the soil survey work should be extended to the insular possessions of the United States, and I recommend that the act making appropriation for the Bureau of Soils be so worded as to permit of the sending of soil survey parties to Porto Rico and Hawaii. Numerous demands have come for the extension of the work in both Porto Rico and Hawaii, and it seems probable that the work will be of particular value to these islands in the present state of the building up of their agricultural resources.

The work has already been started in Porto Rico and in the Philippine Islands, the latter through cooperation with the War Department and the civil government of the islands, in the detail of Mr. Clarence W. Dorsey to the Philippine government and the defraying of his salary and the expenses of the soil survey work by that government. The work can not be continued in Porto Rico nor started by the Department in any other of our possessions without a change in the wording of the appropriation act.

Investigations in Soil Management.

In the development of the soil survey many questions are presented of the possibility of improved methods of cultivation and handling of the crops, as well as of introducing new methods, new crops, and new industries. Some of these suggestions need more time and more study than can be given by the soil-survey parties in the limited time in which they remain in an area. Furthermore, the presentation of such suggestions in printed reports is apt to fail of securing proper recognition from the conservative farmer, who follows pretty much the methods used by himself and his predecessors on the land. Without these further studies and a practical demonstration of their efficiency many of the important results of the soil survey are liable to be lost.

For these reasons a division of soil management has been instituted in

the Bureau, in charge of Prof. Franklin H. King. During the past year exceedingly delicate methods have been devised for the analyses of soils in the field. They are so sensitive that the amounts of nitrates, phosphates, sulphates, and the like, which may be present, as indicated by water solutions, can be determined to within 4 or 5 pounds per acre 1 foot deep. With these methods it is possible to detect throughout the year fertilizers which were applied in the spring, and to trace the movement of these fertilizers from the place where they were applied down through the different depths of the soil. It has been found possible to show noticeable differences in the chemical composition of the soil in the same field, in some parts of which the crops are growing well and in other parts of which they are but poorly developed. It appears that the time has arrived, looked forward to with much interest by scientists and practical men alike, when an analysis will show the need of any particular soil for certain fertilizers. It is too early to make a positive statement of this kind, but the indications are that this can soon be accomplished.

A considerable amount of work has been done with these methods on the soils of eastern North Carolina and of Wisconsin, and quite recently many of the important soil types which have been established by the Bureau in Georgia, North Carolina, South Carolina, Virginia, Maryland, New Jersey, Pennsylvania, and Wisconsin have been analyzed by these methods. These types represent all grades of soil, from the most productive to those which are quite unproductive; soils that are adapted to truck crops, tobacco, fruit, wheat, and corn; and soils under a range of climatic conditions with rainfall varying from 25 to 45 inches per annum.

The results of this work have led us to look upon the soil moisture as a great nutritive solution existing over the surface of the earth, the composition of which is everywhere approximately the same. The soil is a heterogeneous mixture of minerals, the predominant ones being silica, feldspar, mica, and other like silicates, resulting primarily from the disintegration and decomposition of igneous rocks, spread out often through the action of water over vast areas of land. All these minerals are but slightly soluble, and it is not unreasonable to expect that such a heterogeneous mixture of silicates in contact with water should yield a soil solution having sensibly the same composition and concentration. The older experimenters in Germany found that in making up solutions for water culture or for sand culture, the concentration and composition of the nutritive solution must be the same within relatively narrow limits for success in plant development. The results of the past season indicate that the differences in the composition and concentration of the dissolved material in the soil moisture of various types of soil of widely different localities and of different agricultural values are little, if any, greater than the differences to be found in one and the same type of soil under good and under poor farm management.

The "early truck" soil of the Atlantic coast may be deficient in plant food and may require fertilizers for the best development of the crop, but even with such an application as would make these soils as rich in plant food as the prairie soils of the Middle West, these light truck soils could not economically be made to produce as large corn crops as the prairie soils. The difference in the agricultural value of these different types appears to depend not so much upon the chemical composition as upon the physical properties of the soils, and espe-

cially upon their relation to moisture. In other words, the chemical characteristics of the soil influence the yield of crops, while the physical characteristics have generally the greater importance in determining the kind of crop adapted to the soil.

This work will require much further investigation before these statements can be definitely proved. But the amount and character of the evidence so far obtained is such that these ideas may be taken safely as working hypotheses. They are now serving us in this capacity in suggesting and giving direction to studies which are confidently believed to have far-reaching importance for agricultural methods and practice, studies which in all probability could not have been conceived or planned without the investigations which have just been briefly outlined. The results of the work indicate, as might be expected, that the composition of the soil moisture is largely influenced both by the cultivation and by the cropping of the soil, and appear to show in what way and to what extent cultivation can be depended upon to change these important characteristics.

The results of the last year's work also seem to indicate the very superficial nature of the droughts which so seriously affect crops in the Eastern and Middle Western States. It has been frequently observed that in a time of drought, when the surface soil becomes desiccated and the plants are suffering, the subsoil at a depth of 1 or 2 feet contains but little less than the average amount of moisture, and it has frequently been observed that the crops are much more shallow rooted than they are in the far West. This has been variously ascribed to the uniform texture of the soils and subsoils in arid regions, and to other reasons, but the true explanation seems to be that with our frequent and excessive rains in the spring and early part of the growing season, the crops find sufficient moisture near the surface and develop a superficial root system. When the drought comes and the surface soil loses its moisture, the crop suffers because it is not provided with a deeper root system. In the far West, where spring and summer rains are rare, the crop is planted upon a soil which is always uniformly moist to a considerable depth, and with no subsequent rains the plant develops a deeper root system, which enables it to survive long periods of drought that would seriously affect it if it was subjected to frequent showers during the early period of its growth. It is a familiar fact that a lawn which once is watered during a dry season will have to be frequently watered or the grass will suffer oftentimes more than if it had not been watered at all. The first watering induces a superficial root development, which must be supplied frequently with water. What can be done to prevent this tendency and to overcome the effect of droughts is a subject of the utmost importance, and one which will receive the attention it deserves.

I know of no line of work which has been undertaken of more fundamental importance than the work of the division of soil management, nor one which offers a promise of more valuable results to the agricultural interests. When these fundamental problems have been established they will give a reliable basis for the development of better methods of cultivation, fertilization, and cropping.

Tobacco Investigations.

Since my last report the commercial success of the shade-grown Sumatra tobacco in the Connecticut Valley has been assured. Last year 41 acres of shade were erected by 13 farmers, cooperating with

the Department of Agriculture, 35.88 acres of which were planted to Sumatra and the rest to the ordinary Connecticut Havana seed tobacco. The expenses of this work, amounting on an average to about $657 per acre, were borne by the farmers, the Department of Agriculture exercising supervision over the work and directing all the operations. The Department also reserved the right to offer the tobacco for sale, for the purpose of obtaining official information as to the commercial value of the product, which it would have been impossible to obtain if the tobacco had been disposed of at private sale. Accordingly, after it had been carefully cured and assorted under the direction of the Department's experts, the tobacco was catalogued and offered for sale at public auction at Hartford, Conn., on May 1, in accordance with the wishes of the various growers. A committee of tobacco brokers, with Hon. E. Stevens Henry, Congressman from the First district of Connecticut, as chairman, was invited to cooperate with the Department in the management of this sale. The committee consisted of Messrs. M. E. Flaherty, New York; Steven G. Ruth, New York; S. M. Seymour, New York; Capt. Darius Ferry, New York; James Ertheiler, New York; and Herman G. Vetterlein, Philadelphia.

The committee took a great deal of interest in the work and rendered very efficient services in the matter. Credit is due them for the time and expense which they personally contributed in the interest of this investigation and of the Connecticut growers.

The tobacco was offered for sale at public auction from sworn samples. As each grower wanted to sell his crop independently of the others, many of the bales had mixed sizes and even mixed grades. Furthermore, the leaf had not been tried by the manufacturers, and there was some hesitancy in bidding on this account. This accounts for the considerable variation in the price. It is estimated by the Department's experts, as stated in Bulletin No. 20 of the Bureau of Soils, that the tobacco cost on an average, baled and ready for market, about 51½ cents a pound. The ordinary tobacco grown in the open fields in Connecticut brings on an average from 18 to 20 cents a pound. The average price paid for the shade-grown tobacco was $1.20 a pound, the price varying from $2.80 per pound for the best to 25 cents a pound for some of the mixed bales. The crop that brought the best price sold for $1.63 per pound on the average.

On the whole, it is believed that the auction sale was very satisfactory, but it is thought that the prices for this year's crop will be even higher, as indicated by the great demands for the product and by the favorable reports that are coming in from the cigar manufacturers who have used this leaf. The aggregate of the prices obtained at the auction show a very handsome financial transaction.

The total area cultivated in Sumatra tobacco in 1901 was 35.88 acres. There were produced 51,308 pounds of cured tobacco, and actually baled 41,046 pounds, the difference being the loss on account of fermentation, trash, and filler leaves. The total cost of production, estimated at $657.17 per acre, was $23,579.26. The total value, estimated at $1.20 per pound, the average price obtained at the sale, was $49,255.20. This gave a net profit to the growers of $25,675.94, or 108.8 per cent. This does not include the cost of the land, barns, or warehouses, nor the interest on the investment so represented, but does include the whole cost of the shade, the framework of which is expected to last for from five to eight years. The profits per acre were as follows: Of baled tobacco, exclusive of trash, there was obtained

1,144 pounds per acre; the cost of this was approximately $657.17 per acre; the value at $1.20 per pound was $1,372.80; giving a net profit of $715.63. The best crop, which was raised on a lot of about 6 acres, gave a yield of 1,026 pounds per acre; the estimated cost was $649.86 per acre; the total value at $1.63 per pound, the average price obtained for this lot, was $1,672.38, giving a net profit of $1,022.52 per acre.

A great deal of interest has been felt, of course, as to the experience of the cigar manufacturers in handling this product, and the reports have been anxiously awaited. Very favorable notices have been published from time to time in the press and various trade journals, but in order to obtain direct and reliable information the Department addressed three of the largest cigar manufacturers in Hartford and vicinity, who it was known had purchased some of the stock at auction. In reply to these inquiries the following letters were received:

HARTFORD, CONN., *August 25, 1902.*

DEAR SIR: I beg to inclose you my foreman's report on shade-grown tobacco. (Mitchelson, 1901 crop.) The appearance of the crop in the sheds this year shows an improvement in color; there are more brown leaves, with less of the green cast so much in evidence last season. I hope the growers will make a special effort to raise shade-grown wrappers only on land that produces a sure burn. This type is only for wrappers, and a perfect burn is quite important.

Respectfully, yours, CHARLES SOBY.

REPORT TO CHARLES SOBY BY E. M. ROSZELLE, FOREMAN OF FACTORY, ON TEST OF SHADE-GROWN WRAPPERS, MITCHELSON CROP, 1901.

Shade-grown wrappers, as tested under my supervision, will show some remarkable results as to yield of product and of the effect on quality of cigars by their use. By comparison with a like quantity of imported Sumatra wrappers, as to yield in product, the difference in favor of the shade-grown wrappers is apparent to all.

Our test on one bale of shade-grown wrappers of 155 pounds net weight shows the enormous yield of 85,432 cigars, an average of 29$\frac{1}{3}$ ounces per thousand. The same stock, as prepared by the tobacco strippers for the workmen's tables, shows an average of 27$\frac{3}{4}$ ounces per thousand, which includes waste of all descriptions in the stripping room. Our tests on imported Sumatra wrappers of same weights show an average of 70,000 cigars to the bale, with greater loss in stem and wrappers in preparation.

In casing for the stripping room the shade-grown wrappers take the water very nicely and show no bad effects, the wrappers being much easier handled by the caser than Sumatra. It does not become matted, but separates without any trouble.

The workmen find no difficulty in working the leaf, as no loss of time or product is caused by the use of shade-grown wrappers. The leaf is very elastic and works well by comparison with other wrappers tested by us.

The quality of the shade wrappers is excellent and blends very well with our binders and fillers. I am positive the cigars are improved in quality by its use. I find no trouble with the burn of the leaf in my daily inspection of the wrappers. I have failed to find a single leaf that does not burn perfectly.

As to color, they are not perfect in all respects. I find that about 91 per cent of the stock tested by us was good in color.

All things considered, the points in favor of the shade-grown wrappers may be summed up as follows:

First. Greater yield in product.
Second. Leaves are lighter in weight and color.
Third. Less waste and cost in preparation for workmen's tables.
Fourth. Less loss in weight of stems as compared with Sumatra wrappers.

Respectfully, yours,

E. M. ROSZELLE.

SUFFIELD, CONN., *September 4, 1902.*

DEAR SIR: It is but right I should advise you as to the working quality of the Connecticut shade-grown Sumatra tobacco, from which I purchased at the sale in Hartford, Conn., on May 1, 1902, 20 bales.

I have worked in my cigar factory since then quite a proportion of this tobacco, and I am more than pleased with the results; it is finer and better in every way (in color, texture, and flavor) than the imported Sumatra, and the wrapping qualities are enormous; 20 ounces will easily wrap 1,000 5-inch cigars. I am confident that when cigar manufacturers come to work this tobacco the demand will be far greater than the supply.

Very respectfully, yours,

L. P. BISSELL.

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HARTFORD, CONN., *September 1, 1902.*

DEAR SIR: We have been using the shade-grown tobacco, which we bought at the auction held in this city last May, to some extent all summer. We are using it on a small "perfecto" cigar. It wraps with about 2 pounds to 1,000 cigars. The colors have improved a great deal since last spring. It burns well and tastes well. So far we have not had any complaints from any of our customers about the cigars with this wrapper. We should like it better if it had a little more body, because then it would stand the cold weather better.

Very truly yours,

LEICHKE & PLETCHER.

In another communication Messrs. Leichke & Pletcher report that they could wrap 1,000 of their 5-inch cigars with 1 pound 10 ounces of the leaf, while Mr. Bissell, of Suffield, reported that he was using 2 pounds of the shade-grown leaf to wrap 1,000 of his cigars, and that with a bale of wrappers weighing 140 pounds 102,000 cigars were wrapped. It can safely be said, therefore, that the leaf has successfully stood the test of the cigar manufacturer.

Even before the tobacco was ready for the market or the results of the sale announced, preparations were made by the growers to largely increase the acreage. Although the commercial success of the investigations had been fully demonstrated, the industry was so important and involved such an expenditure of labor and capital that, at the earnest solicitation of the growers, the Department's experts were left in the Connecticut Valley for another year to advise with such of the growers as needed their assistance. At the present time the Department is advising and instructing in this way 38 growers in Connecticut and Massachusetts, cultivating 645 acres of shade tobacco. The efforts of the Department in this direction seem to be very highly appreciated.

The season has been distinctly unfavorable. There has been an unprecedented amount of rain, falling in very severe showers, and the season as a whole has been characterized by cool spells and especially cool nights. This has apparently not affected the crop materially, as it is the general belief that the crop at this time is better than that of last year. The season has also been one of unusually severe wind and hail storms. Considerable damage has been done to the outside crops in certain sections of the State, but no damage has been done to the shaded tobacco, as the cloth has protected the leaf from all injury from hail. The damage from wind has also been exceedingly light. The winds have been so strong in places that the posts have been lifted from the ground, but the damage to the tents has been exceedingly slight and there has been practically no injury to the crop.

As to the financial prospects for this year, the following estimate is based on the experience of last year: There are about 700 acres of tobacco under shade, which will produce about 1,000,000 pounds of

cured tobacco, or 800,800 pounds of baled tobacco, exclusive of trash. The total cost at $657.17 per acre, the average for last year, will amount to $460,019. The total value of the baled tobacco at $1.20 per pound, the average price obtained at the auction, will be $960,960. The net profit will be $500,941. It is believed, however, that the cost per acre will be considerably less than last year, and that the price per pound will be greater. The Department believes that this industry has been successfully placed upon a commercial basis, and that there will be a considerable increase in the crop grown next year. We have demonstrated our ability to produce a leaf which is desired by our people and for which about $6,000,000 have annually been expended in foreign countries. The demand for this product has always been greater than the supply, and prices have been maintained in a remarkable manner. It may seem strange to some that manufacturers can afford to pay such prices for wrapper leaf, but even at $3 a pound for leaf that will wrap at the rate of 2 pounds to 1,000 cigars, the cost of the wrapper is about six-tenths of a cent. Even at such prices the leaf can profitably be used on a 5-cent cigar. There is so little waste to the leaf, it yields so well in the manufacture of cigars, the color is so uniform, and the grading is so perfect that manufacturers find it actually cheaper to pay $3 a pound for such leaf than to buy domestic wrappers at an average of 20 cents a pound or selected domestic wrappers at from 50 to 60 cents.

SUMATRA TOBACCO IN LOCALITIES OTHER THAN CONNECTICUT.

Considerable interest has been shown, of course, in the possibility of extending the Sumatra tobacco industry to other localities and to other States. It was predicted, as a result of the soil survey of the Lancaster area, Pennsylvania, that the Sumatra tobacco could be successfully grown under shade on the narrow strip of Donegal gravelly loam bordering the Susquehanna River. Experiments carried on this year by the Pennsylvania experiment station, in cooperation with this Department, in growing Sumatra tobacco under shade on a small tract of about 1 acre, appear to have demonstrated the correctness of this prediction. The crop has been harvested, and, judging from the product in the curing shed, it is of good quality. It is not believed by the Department experts that equally successful results will be attained on other soils in this area.

In response to demands from one of the principal New York tobacco districts, a soil survey was made this season of the Big Flats area in the Chemung Valley, New York. As a result of this survey, it is not believed by the Department experts that any considerable success will attend the growing of Sumatra tobacco on the soils of that locality, with the exception of a very small area of not exceeding 10 acres, where an experiment has been actually carried on by a gentleman familiar with the soils of the Connecticut Valley, who selected this tract because it represents the type of land that is found in Connecticut.

A soil survey has also been made of a considerable area in the Janesville area, Wisconsin. Two experiments of growing Sumatra tobacco under shade have been tried there, and the results at the time of harvesting indicate a fair degree of success. The Department does not believe, however, that the product of the soils of the Janesville area will approach in quality or in value the product raised in the Connecticut Valley. It is not intended by this to imply that the leaf can not be successfully grown in the Wisconsin area, but from

the information at present obtainable it does not seem that the product will be of equal value with that of the Connecticut Valley. The Department is still of the opinion that the conditions essential for the raising of a high grade of Sumatra tobacco are limited in extent and can be closely defined by the soil survey.

INVESTIGATIONS IN THE FILLER TOBACCO DISTRICTS.

The experiment of raising Cuban filler in Lancaster County, Pa., last year was not a success. It is believed, however, that this was due to a misunderstanding with the growers and a consequent lack of care and thoroughness in the cultivation and handling of the crop. While it was thought that these investigations should not have been interrupted or discouragement felt at the lack of success in this first attempt, it was impossible for financial reasons to maintain a party in Pennsylvania, as a promise had already been given to start the work in Ohio. Accordingly, more careful plans were made, and a crop was grown on the upland soils of the Miami Valley under the direct and immediate supervision of the Department's experts. This crop has just been harvested, and it is too early to determine the value of the product. From other crops that have been raised in the locality from imported Cuban seed, which have been fermented by our experts and thoroughly examined, it would appear that a desirable type of leaf, approaching very closely the imported Cuban leaf, can be produced. The quality of the leaf is not at present all that could be desired. There is something harsh about the aroma, but it is thought that this can be considerably toned down, if not entirely eliminated, by thorough methods of cultivation and fermentation.

The tobacco situation in Texas has been thoroughly studied, and it is thought that a desirable leaf will be produced there by careful methods of cultivation, fermentation, and assorting.

CONFERENCE OF TOBACCO EXPERTS.

A conference has recently been held in Washington by the tobacco experts of the Department to consider the general situation and to advise as to the methods to be pursued during next season, especially in Ohio and Texas. The call for the conference was as follows:

GENTLEMEN: You are called together to confer with one another and to apprise me as to several points in reference to the present condition of the tobacco industry of the United States, with particular reference to the development of the future plans of the Bureau of Soils in connection with the tobacco investigations.

Your discussion will necessarily embrace a wide range of subjects, but I would like you particularly to consider the following points:

The question to be considered is whether a filler leaf can be produced in any part of the United States closely approaching the best type of leaf grown in the island of Cuba, with the characteristic mildness of flavor and with the aroma which that leaf possesses. If we can not produce tobacco equal to the finest Cuban leaf, can we produce tobacco equal to the average Cuban leaf imported into this country?

It has been the opinion of the Bureau that the closest approach to the Cuban leaf has been produced in Ohio and Texas. A number of samples of Ohio tobacco will be submitted to you by Mr. Massey, who should be able to give you very clear information in regard to the character of the crop and the possibilities of improved methods of cultivation and fermentation. I wish you would examine this tobacco critically, leaf by leaf, and see whether the character of the leaf, that is, the size, shape, texture, and body, is such as we want to produce, and whether this really compares favorably in these several qualities with the sample of imported Cuban leaf which is submitted to you by Mr. McNess. You will also see if any of

these Ohio leaves, selected either from different crops or from different methods of handling or from different seasons, have the qualities possessed by the Cuban leaf; whether they have the same mild flavor and whether there is any approach to the aroma.

Having considered these questions carefully, you will then consider the possibilities of changing this leaf. If any radical change is to be made in the physical character of the leaf, that is, as to its size, shape, texture, or body, you will advise as to how these changes can likely be produced; whether by change of seed, by selection of different soils, or by change in the method of planting and cultivation; and also as to the method of subsequent handling, fermentation, petuning, and aging.

Having considered this matter of the texture of the leaf, you will then take up the flavor and aroma and advise as to whether it is likely that these qualities can be improved, and what methods we now possess that are likely to influence the flavor and aroma of the leaf.

If, as a result of your conference, it appears possible to effect desirable changes in the Ohio tobacco, I should like you to consider the commercial aspect of this question, stating the probable cost of production of a more desirable leaf by improved methods of cultivation and handling, and particularly to consider the price at which this leaf could be sold on the market with a fair profit to the growers. Also, what grade of cigars this could be used for.

If you arrive at any favorable conclusion as to the physical possibility of growing a more desirable filler and as to the commercial possibility of producing this filler profitably to the growers, I wish you would then confer as to the methods to be pursued by the Bureau in developing this experimental work.

You will take the foregoing as an outline of the scope of your discussion in regard to the Texas tobacco, and will examine the samples Mr. Shelfer submits and consider the questions that he will bring before you, and will then advise on the several points above outlined in regard to the possibilities of growing the filler leaf in Texas and of the methods for continuing the investigations in that State.

MILTON WHITNEY,
Chief of Bureau.

Pursuant to this call, and after a four days' conference, the committee made the following report, which will be of interest to tobacco men:

REPORT OF THE COMMITTEE OF TOBACCO EXPERTS.

SIR: Having met together in conference in pursuance to your call, and being guided by the memorandum prepared by you, we have come to the following conclusions in regard to the subjects mentioned in said memorandum:

Report on the Ohio work.

Mr. Massey has submitted to us various samples of Zimmer Spanish, Gebhart, and other types of Ohio tobacco, and also leaf from the first year of seed imported from Cuba, grown both on the uplands and the bottoms. He also submitted samples of cured but unfermented leaf raised from imported Cuban seed this season by himself on the uplands in Montgomery County, Ohio.

We are of the opinion, after an examination of this material and after listening to the report by Mr. Massey, that the leaf grown from the freshly imported Cuban seed on the upland soil, known as the Miami clay loam, closely resembles, in form and physical characteristics, the imported Cuban leaf. This refers to the size, shape, color, grain, and general style of the leaf. Samples of this leaf were closely compared with samples of good imported Cuban leaf, and it would have been impossible for anyone to have told the differences from the mere handling and inspection of the leaf. So far as flavor and aroma are concerned, the committee found a considerable difference in individual leaves, as there is in the imported Cuban leaf. They were able to select about 33 per cent of well-cured, heavy-bodied, rich-grained leaf that was quite comparable in its aroma and flavor to the imported Cuban leaf. The Ohio-grown leaf, however, had a certain rawness and roughness noticeable both in the flavor and in the aroma of the smoke, and it has not the smooth, mellow character of the imported leaf. Your committee believe, however, that with leaf of this character, as submitted from Ohio, if the leaves are allowed to ripen thoroughly and the fermentation by the bulk method be carefully and judiciously carried on, taking, if necessary, two or three months for the original fermentation and allowing time for the leaf to age, first in bulk

and afterwards in Cuban packages, this harshness can be smoothed out and a considerable portion of the leaf brought up to the standard of the Cuban trade.

We believe that this investigation should be continued along the same lines, giving careful attention to the cultivation of the crop, to its fermentation and aging, so as to produce a rich, mellow leaf, and that then more attention should be given to assorting the leaves, so as to arrange them in different classes and determine in this way the proportion of very desirable leaf, and the physical characteristics of this leaf, and then endeavor to decide whether the proportion can not be increased. We believe it wise at present to confine the work to a narrow line which seems to promise success, using no commercial fertilizers, but relying upon a liberal application of stable manure, close planting, good cultivation, and the most careful and thorough fermentation. So far as any change in the character of the leaf is concerned, the committee feels that at this time it would be inadvisable to depart, in any way, from the lines that have been laid down, as the leaf that has been produced appears to have a perfect form, size, and texture, and we believe that more careful handling will develop the other qualities desired.

Objection is made by the Ohio growers that the cost of production of the Cuban type exceeds that of the Zimmer Spanish and other Ohio types of tobacco, and unless they are guaranteed a higher price for the Cuban they are not going to grow it. It appears from the evidence, however, that the yield of Zimmer Spanish tobacco ranges from 800 to 1,000 pounds per acre. The Zimmer Spanish is planted 24 inches in the row, in rows 3 feet apart. The plant from the imported Cuban seed is a smaller plant and the leaves are smaller and thinner than the Zimmer Spanish, but the plants are grown 12 inches apart, in rows 3 feet 6 inches apart, so that the yield per acre from the first-year crop of Cuban seed tobacco is the same or possibly more than of the heavier bodied Zimmer Spanish. The crop from the imported seed, however, is more delicate, needs more careful cultivation, much more frequent suckering, and is more difficult and expensive to harvest, on account of the more fragile nature of the stalk and the greater number of plants to the acre. It is believed, however, that the cost of production will not be 1 cent per pound more than for the Zimmer Spanish.

In regard to the methods of continuing the investigations in Ohio, the committee believes that a single experiment of 10 acres, located on the Miami clay loam, with an additional 5-acre tract located on the Miami gravelly loam of the second bottom, should be carried on by the Department. Mr. Massey and his assistants should have complete control of the growing and handling of the crop. We believe that the Department should not extend its operations to any other localities in the State at this time. We consider it unwise to attempt any fertilizer experiments, but would rely upon liberal applications of stable manure, giving careful attention to the methods of cultivation and attending particularly to the fermentation and aging of the leaf.

As respects the final disposition of the tobacco, we are of the opinion that the ownership should rest in the owner of the land, but that the Department should reserve the right to take such samples as may be needed and actually to offer the tobacco for sale, in order to secure an official estimate of the views of commercial tobacco men, but that it should be under no obligation to advertise the tobacco except in the interest of a fair and impartial estimate of its commercial value, in case the Department thinks it would be to the public interest to have such information.

Report on the Texas work.

A large number of samples of Texas-grown tobacco were submitted by Mr. Shelfer. These samples represent different parts of the State, and full information as to the conditions of the different localities was given by Mr. Shelfer, especially as to soils upon which the tobaccos were grown. It is evident from this examination that the character of the soil has a very remarkable effect upon the character of the leaf, even where the same seed is used. The leaf grown on the "red lands" (unnamed and unmapped as yet by the soil survey), as appears from the samples, if grown from freshly imported Cuban seed has the physical characteristics of the Cuban leaf, and when properly fermented can not be told by a physical examination. It has the same style of leaf as that submitted by Mr. Massey from crops grown in Ohio from imported Cuban seed. The flavor and aroma, however, are slightly more harsh than in the case of the Ohio tobacco, and the leaf needs toning down and mellowing. We believe this can be done in the manipulation of the fermentation and aging of the leaf. Crops grown, even on this land, from Texas-raised seed depart very materially from the Cuban type of filler tobacco, so that it is advisable to at present use only the imported Cuban seed.

Samples submitted from one soil of San Patricio County come next in appearance and quality to the leaf grown on the red lands above referred to, indicating that some desirable results might be attained from investigations carried on in this soil. The leaf from all other soils submitted, however, departs widely from the Cuban type of filler, and is considered undesirable for filler grades. Even leaf grown this year from imported seed by Mr. Shelfer on the Willis sand and the Norfolk sand in Montgomery County has not the physical characteristics of the desirable filler type of leaf.

Regarding the continuance of the experiments in Texas, we recommend that Mr. Shelfer continue his work on the fermentation and aging of the leaf to try to produce a more mellow article. In our judgment there is not sufficient leaf at present available to test in any satisfactory way its commercial value, and it will be necessary before this can be determined to have a larger quantity of leaf for the Department to handle. We think it advisable for Mr. Shelfer to arrange next year to establish his headquarters at some point convenient to the red lands area and arrange with some responsible grower for about 10 acres of tobacco to be grown on the red lands from seed furnished by the Department and under Mr. Shelfer's supervision. In addition to this it appears from the evidence submitted that there is a fair prospect of producing a good quality of filler leaf on the soils in the vicinity of Rockport, San Patricio County, and it would appear desirable to try the Cuban tobacco under the climatic conditions prevailing there. It seems wise, therefore, to arrange with one grower in that locality to provide sufficient leaf grown under the direction of the Department to enable an experiment in grading, assorting, and fermenting the leaf under expert supervision.

We believe it would be unwise to excite any very great or general interest in the work or any high expectations of producing tobacco of fine commercial grade, or which will bring a large price, until the Department has had a chance in this comparatively small way, but with thorough methods, to see if the unfavorable qualities recognized in the Texas leaf can be overcome and a leaf of desirable quality obtained.

The Department should reserve the same rights as regards samples and the sale of the tobacco as are provided for in the case of the Ohio-grown tobacco.

GEO. T. MCNESS.
GEO. B. MASSEY.
L. H. SHELFER.

WASHINGTON, *September 1, 1902.*

On the adjournment of this meeting, as the prospects seemed to all very favorable for the ultimate success of the work, two of the tobacco experts were sent to Cuba for a short time to obtain certain information that will be of benefit to the Department in its work.

SALARIES OF TOBACCO EXPERTS.

The demand for experts to carry on tobacco investigations has been so great that Mr. Floyd, although receiving as high a salary as, in justice to other officers of departments, it seemed possible to pay him, and who at the time was getting a larger salary than the chief of the Bureau who was directing the work, was induced to leave by the offer of compensation about three times as great as he was receiving in the Department. Quite recently his successor has been approached in the same way by a corporation intending to operate in the Connecticut Valley, and it is likely that he will leave the Department to accept a much more remunerative position outside. Two years ago I had to note the loss to the Department of a gentleman who had made some important discoveries in tobacco fermentation, and who was called to Japan at a salary about four times as great as he was receiving in the Department

It is gratifying to feel that the Department's experts are looked upon with such favor in the commercial world, but these experts are so difficult to obtain, and to train them requires so long a time, that the Department is very greatly embarrassed when they are thus removed

because of lack of opportunity to pay them what their services are worth in commercial lines. As this work has been developed by the Department, it seems strange to think that the very success of the work is hindering, if it does not prevent, the successful extension of the investigations.

EXTENSION OF THE TOBACCO INVESTIGATIONS.

The tobacco investigations of the past two years have been carried on with three field parties, at a cost of about $5,000 each, or an aggregate of $15,000 per annum. On account of the great success of this work, and the extraordinary interest taken in its extension to other areas, I recommended last year that the appropriations for the Bureau of Soils be increased so that the allotment for this work could be made sufficient for seven parties of tobacco experts. The appropriations as passed, however, did not allow of this increase, and the allotment this year has been the same as for last. The demands for the services of these tobacco experts have been very great, and I would recommend that three additional parties be organized for work in Pennsylvania, Wisconsin, and North Carolina. This will mean an increase of $15,000 in the allotment, making in all the sum of $30,000 for the tobacco investigations. I feel that the economic results of the work so far done, and the lines of work that are at present being developed, fully justify this recommendation. The reports from the Connecticut Valley alone indicate that nearly $1,000,000 worth of Sumatra tobacco will be grown in the State this year. This has largely increased the price of land; has furnished a market for thousands of chestnut posts from adjacent ridges which have lain idle and unproductive for years; has given employment in a healthful occupation and at remunerative wages to large numbers of men and women; has brought about the production of millions of square yards of cloth by the cloth manufacturers, and has opened up the possibility of an enormously profitable industry for the future. It would seem that this experiment alone would fully justify the increase in the allotment that is asked, but when it is stated that we expend annually $8,000,000 for filler tobacco which the experts of the Department believe can be produced in this country, it but adds to the justification of the request for the larger allotment for this work.

Drainage Investigations.

During the year an investigation was started as to the possibility and practicability of reclaiming the soils in the arid regions which have been injured by seepage water and the accumulation of alkali. In cooperation with the Utah experiment station and Mr. C. D. Swann, of Salt Lake City, who has donated land for the purpose and has paid a considerable portion of the field expenses, a tract of 40 acres of alkali land near Salt Lake City has been thoroughly underdrained with tile. This work has been under the immediate supervision of the Department experts, and the work of reclamation is to be under the joint charge of the Department and the Utah experiment station. It is too early yet to speak of the results of this work. It is being watched with the greatest interest by the people of that locality, and it is believed that if the investigation is a success ample capital will be forthcoming to carry on extensive operations in the reclamation of

alkali tracts and the prevention of damage to irrigated lands from seepage waters. This work is under the immediate charge of Mr. W. H. Heileman.

Arrangements are being made for the carrying on of similar work at Fresno, Cal., and it is proposed to extend this work to a typical area in Montana and possibly in Arizona, to demonstrate to the people that these unfavorable conditions can be economically controlled. It is estimated that land values in the immediate vicinity of Salt Lake City will be increased at least $3,000,000, exclusive of the cost of reclamation, if they can be reclaimed from the alkali with which they are now impregnated, and it is believed that equally great benefits will result in other portions of the arid West.

In furtherance of this work, Mr. Thomas H. Means, of the Bureau of Soils, has accompanied Mr. Thomas H. Kearney, of the Bureau of Plant Industry, on a trip to Algeria and Egypt to study the treatment of alkali lands, the use of alkaline waters in irrigation, the methods used in the reclamation from seepage water and alkali, and the crops adapted to alkali soils. This investigation has not yet been completed, but sufficient has been heard from the party to indicate that conditions even more serious than those existing in the arid regions of this country are under perfect control, and it is believed that the information thus gathered will be of great benefit to the people of Western America.

REPORT OF THE ACTING ENTOMOLOGIST.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., August 2, 1902.

SIR: In the absence of the Entomologist, I submit herewith an executive report covering operations in the Division of Entomology for the fiscal year ended June 30, 1902, dividing it, in accordance with the directions contained in your circular letter of July 12, into the following sections:

(1) A review of the operations carried on during the fiscal year 1902.

(2) An outline of the plans proposed for the work of this Division for the fiscal year 1903, under the appropriations for that year.

(3) So much in reference to the plans of work recommended for the fiscal year next following, ending June 30, 1904, as may be of assistance in the preparation of estimates for that year.

The detailed estimates for carrying on the work of this Division include the plan for the reorganization of the entomological service of the Department of Agriculture into a Bureau of Entomology. An explanation in full detail of the proposed bureau organization is given in the recommendations for the fiscal year ending June 30, 1904.

Respectfully,

C. L. MARLATT,
Acting Entomologist.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

The work of the Division of Entomology may be classified as follows:

Work on insects from abroad, including (1) the fig-fertilizing insect; (2) the San Jose scale and its Asiatic ladybird enemy; (3) importations of other beneficial insects; (4) caution relative to importation of foreign insects.

The South African grasshopper fungus.

Work on scale insects.

Investigations on insects injurious to truck crops.

Investigations on insects damaging forests.

Work on insects injurious to shade trees.

Work on the Mexican cotton boll weevil.

Work on the codling moth in the Northwest.

Work on insects injurious to stored products.

Work on insects affecting greenhouse and other ornamental plants.

Work on insects injurious to citrus trees and fruits.

Investigations on insects in their direct relation to the health of man.

Unclassified work on injurious insects.

Experimental work with insecticides.

Work on the geographical distribution of injurious insects in the United States.
Apicultural investigations.
Technical work.
Bibliographical work.
Correspondence.

WORK ON INSECTS FROM ABROAD.

THE FIG-FERTILIZING INSECT.

As a further report of progress on the introduction and establishment of the fig-fertilizing insect from Algeria into California, referred to in previous reports and especially summarized in the report for 1901, it may be said for the year 1902 that thousands of figs containing the insects successfully withstood the winter climate of California, and an unlimited amount of fig insects were available at the proper time for caprification in the spring of 1902, resulting in the production of some 50 tons of Smyrna figs in the sole commercial orchard in existence at present, that of Mr. George C. Roeding, at Fresno. It was further found that the fig insect successfully hibernates at Niles, Cal., and there is now no longer any danger of its dying out. In other words, the entomological problem of Smyrna fig culture in America is solved, and what remains to be done belongs rather to the domain of horticulture—namely, the introduction of more caprifig trees, improvement in the methods of curing and drying the fruit, and the determination of the regions throughout the arid West suitable to the industry. The practical success of Smyrna fig culture in California is now only a matter of time. In a very few years Smyrna fig orchards will be in bearing in many places in California, and doubtless in other Western States where climatic conditions are favorable. As stated in the report for 1901, Mr. Roeding spent nearly a year in Smyrna studying the methods of fig culture in that country under a commission from this Department. Much valuable data were obtained, for the most part appertaining to the horticultural side of the problem. The future of this industry, which promises to be one of the great industries of the arid regions of the West, becomes more promising every year.

THE SAN JOSE SCALE AND ITS ASIATIC LADYBIRD ENEMY.

In the report of last year attention was called by Dr. Howard, Entomologist of the Department, to the exploration which was being conducted by the writer in Japan and China to discover, if possible, the native home of the San Jose scale (*Aspidiotus perniciosus*), and also to find native parasites and enemies which might be imported to control or at least check the damage which is done by this insect in the deciduous orchards of this country. The writer's exploration of Japan demonstrated that the San Jose scale is not a native of that country, as many of our entomologists had supposed, but, on the contrary, that it had come to Japan comparatively recently on imported nursery stock and been thus spread somewhat generally over the islands of the Japanese Empire. Subsequent to the time covered by the report for 1901, in the late summer and fall of that year, the writer extended his explorations to China, exploring the coast region from Shanghai northward to Pekin. The evidence from native fruits and wild plants in the region about Pekin and south of the Great Wall established

very clearly that the original home of the San Jose scale was in this region. In brief, this scale insect was found on wild haw apples, native crab apples, and native pears grown in the region indicated, where no foreign fruit stock had ever been introduced. Furthermore, it was found in scattering numbers everywhere, just as one would expect in the native home of a pest of this sort where it is normally kept in check by natural enemies. There can be no doubt that at last its original home has been located. It was probably brought to America many years ago on imported Chinese flowering peaches or some other ornamental or flowering shrub from this region, having first appeared in the gardens of a great importer of ornamental and other plants in San Jose, Cal. A very interesting fact in connection with this discovery was the finding in this same region of a ladybird which preys on this scale insect naturally and seems to be the principal agent in preventing its often becoming very abundant and injurious. This ladybird (*Chilocorus similis*), a European and Asiatic species, in China feeds naturally on the San Jose scale and related forms, as also on the white peach scale, a very troublesome pest which has recently gained foothold in our Eastern and Southern States. Several shipments of this beetle were made—some from Japan and some from China. Unfortunately, all perished but two, this mortality resulting from the long confinement of the six or seven weeks' trip from Asia, and the unfavorable condition under which they were kept in Washington during the winter. From the two surviving individuals more than a thousand beetles and larvæ are now on scale-covered trees on the Department grounds. Shipments of these beetles to other points in the East have already begun, a number of experiment station entomologists having expressed a desire to assist in the work of propagating, distributing, and establishing this useful ladybird. This importation promises most flattering results at present. It is, however, still an experiment, and what the ultimate benefit will be can only be determined after a two or three years' test. We hope to establish it in this country and to get from it some of the good results, at least, which it evidently accomplishes in China and Japan. It doubtless will often be necessary in the future to spray or otherwise treat infested trees in commercial orchards, but the Chilocorus will probably be of very great assistance in keeping in check the San Jose scale in the thousands of gardens and small orchards of individuals who have no commercial interest at stake, and who would not, ordinarily, take any means to keep this scale insect from multiplying on their trees, thus forming centers for contagion.

IMPORTATIONS OF OTHER BENEFICIAL INSECTS.

The preliminary attempts to introduce the European enemies of the gipsy moth have been continued, and it is further hoped that Dr. Howard, who is now in Europe, may be able to make arrangements with different individuals there which will result in greater success in future importations. The difficulties attending the importation of the predaceous beetles from Europe to America are considerable, and to get them established in this country will demand the careful cooperation of agents or interested individuals on the other side.

The black scale of the orange is the most destructive, perhaps, of all the orange pests in California, and the South African parasite of this scale insect, which we have been endeavoring to establish in California for the last year or two, still gives promise of ultimately becom-

ing a fixture and doing the good service in our Western orange districts which it now does in South Africa and in Italy. The history of this importation was given in the report of last year. A recent report from Mr. Alexander Craw, who is looking out for this experiment, indicates that the parasite is breeding abundantly. With a beginning of only two female insects, kept in captivity, he has sent out to different localities up to July of this year (1902) twenty-five colonies.

A very important European parasite of the larger scale insects, such as the Lecaniums and mealy bugs, has been imported during the year. The larva of this insect (*Erastria scitula*) feeds on scale insects, and it is hoped that its introduction into our citrus districts especially will be of great advantage, as it will prey upon certain of the larger scale insects affecting citrus trees. The effort is being made to establish this predaceous insect in California, with the cooperation of Mr. Craw, the horticultural quarantine officer, and Mr. Ehrhorn, of Santa Clara. These insects have already been liberated in Santa Clara, Los Angeles, and Niles, Cal., and the outcome of this effort at the introduction of a useful insect will be watched with interest and the utmost care will be taken to bring it to a successful issue.

Another foreign insect promising great usefulness in a different direction has been imported during the past year. This insect, the European ladybird (*Coccinella septempunctata*), was sent from Hungary, through the kindness of Professor Sajo. Some 40 beetles were received in the autumn of 1901, more than half of which successfully hibernated, and during the spring and summer of 1902 have multiplied in sufficient numbers to enable the Division by fall to send out colonies to experiment stations and to individuals who will properly care for them. These ladybirds feed on plant lice, and should be an efficient aid in controlling the destructive insects of this class which infest cotton, peas, melons, and other vegetables, and the fruits. Some of these insects have been sent to Mr. Craw, in California, where they give promise of becoming established. Another ladybird (*Leis conformis*), a plant-louse feeder also, was imported from Italy and liberated in California. A further importation of this species may be necessary to effect its establishment here.

This work, of an international character, has not been altogether one-sided. In other words, while we have been importing foreign insects and have been receiving a good deal of gratuitous assistance from entomologists abroad in this work, we have paid our debts, to a certain extent, by sending to foreign countries some of our beneficial insects. The extraordinary success in preventing damage from the white scale, once a great orange pest in California, by the introduction of the Australian ladybird, has been duplicated, as made evident in former reports, in many foreign lands, notably South Africa, Portugal, and Egypt. During the last year colonies were sent from California, at our request, to Dr. Antonio Berlese, Portici, Italy, where this same white scale insect had established itself. Recent reports indicate that this exportation has proven to be another of the series of successes which has attended this insect wherever it has been sent to work against its notable scale insect host. We have also had sent, through the kindness of Mr. Craw, various beneficial ladybirds to the Bermuda Islands to assist in keeping in check the noxious scale insects occurring on these islands.

CAUTION RELATIVE TO IMPORTATION OF FOREIGN INSECTS.

It will be noted that a great deal of work has been undertaken by this Division during the past year in the importation and distribution of predaceous and parasitic enemies of destructive insects. A word of caution should be added in this connection. There is danger in the promiscuous importation of insects as much as in the case of other animals, and the evidence which we now have would seem to indicate that the importation of any insect which is a general feeder on other insects may be a matter of harm rather than benefit; in other words, any general feeder is just as liable to devour beneficial insects as injurious ones, and in this way may do more harm than good. The effort which has been made to artificially hasten the dissemination of the European praying mantis seems to be a case in point. This insect feeds on all sorts of larvæ, and, unfortunately, has a very decided liking for our beneficial ladybird larvæ. Importations, therefore, can not be undertaken promiscuously or by persons who are not fully acquainted with the food habits of the imported insects. The introductions in which the Department itself has been interested and for which it is responsible have been in the main of species of limited food habits; in other words, insects which feed only on certain restricted kinds of injurious species, and are not general feeders or general parasites. The benefit to be derived from judicious and intelligent importations may amount to millions of dollars, as has already been demonstrated in some historical cases in this country. Very great but perhaps not corresponding injury may result from unfortunate introductions. It seems, therefore, advisable to make some effort to control such foreign importations by having all such work go through the hands or be done with the advice, at least, of this Department.

THE SOUTH AFRICAN GRASSHOPPER FUNGUS.

The report of last year contained an account of the work of this Division with the South African grasshopper fungus throughout the Mississippi Valley and Colorado region in cooperation with the Bureau of Animal Industry. The experiment has been continued the present year and much extended, the intention being to give this fungus a thorough and practical test to demonstrate whether it can really be counted on as a means of controlling the locust or not. As reported by Dr. Howard in the Yearbook of this Department for 1901, the number of experimenters last year during the entire season was 223. For this season, at the time of writing only half over, the Division has already sent cultures of the fungus to 886 individuals. This does not include the perhaps even greater number of cultures which have been locally prepared by various individuals, and especially by Prof. C. P. Gillette, of the Colorado State Agricultural College, who has taken charge of the culture preparations and their distribution in his State. Very few of the persons to whom cultures have been sent have yet reported, it being still too early in the season to determine the outcome. These cultures have been sent out to 25 different States and Territories, and so far 9 reports of success have been received, 36 of failure, and 821 remaining to be heard from. It is now too early to give definite judgment, but it seems probable that very great reliance can not be placed on this fungous disease. Either it does not work with our grasshoppers as readily as it does with the

South African locust, or our climate makes our species of grasshopper more resistant, or the fungus less operative.

WORK ON SCALE INSECTS.

The important work of the year on scale insects has been the investigation of the San Jose scale in China and Japan, referred to under "Work on insects from abroad." The experimental work on the San Jose scale at home has been continued, and Circular 42 (second series), describing the methods of controlling this insect, has been revised to include the results of the latest information on methods of treatment.

This office is looked upon as the chief source of information upon scale insects, few of the experiment stations having collections or literature sufficient to enable the determination of specimens; hence much work is done every year in determining material for station entomologists and for private individuals throughout the country. In addition many large collections of scale insects have been received for study and determination from foreign countries, notably from Australia, New Zealand, the Bermudas, and Italy. In the trip of the writer through Japan and China, Java, and other countries in the Orient, a particular study was made of the scale enemies of fruit trees, and large collections of this class of pests were brought home from the countries visited. The knowledge gained from the study of the preserved specimens will be of great practical importance. It will acquaint us with the scale pests of these countries, which are being brought into closer commercial relations with the United States, a knowledge which is desirable because these insects are more apt in the future than in the past to reach our shores through importations of fruit trees and ornamental stock. The scale insects of foreign countries are perhaps the most important pests to be considered in all quarantine and other operations looking to the protection of our growers from foreign invasions, since these insects live for the most part attached to the bark of trees and are much more apt to be brought in with plants than are other insects.

WORK ON INSECTS DAMAGING FORESTS.

During the year several important investigations were made of forest insect depredations by Dr. A. D. Hopkins, of the West Virginia experiment station, who was employed, at the request of Mr. Gifford Pinchot, of the Bureau of Forestry, as a temporary agent of this office for the purpose. Great loss of pine timber, to the amount of more than 226,000,000 feet (board measure), in the Black Hills forest reserves was found to result from the work of a bark-beetle mining under the bark of living trees. Numerous facts were determined relative to the life history of this insect, and it was possible to detail practical methods the adoption of which would prevent future losses. A report of this investigation is published in Bulletin No. 32 (new series) of this office. The present summer this work was continued by the detailing of a student assistant in the Bureau of Forestry to carry out experimental work in the Black Hills region looking to the control of this destructive beetle. These experiments, carried on under the direction of Dr. Hopkins, have been meeting with excellent success, and some very important and practical results are being attained.

Another investigation, also conducted by Dr. Hopkins, was made in November, 1901, of hickory and other forest trees near Geneseo,

N. Y. The hickories had been killed by a bark-beetle, the damage having already gone beyond repair for most of the region invaded. Had an earlier report of the difficulty been made to this office a prompt application of known methods of control would have prevented this loss. A special report of this investigation will soon be published. The damage occasioned by this hickory bark-beetle seems to be quite general throughout the Northern United States and will be given considerable attention in the future, especially now that Dr. Hopkins has been definitely employed by this Division as expert in forestry insects.

WORK ON INSECTS INJURIOUS TO SHADE TREES.

Owing to numerous complaints of insects affecting shade trees that have been received in recent years, considerable study has been devoted to this subject, and in particular to the species that are comparatively unknown or new to this country, including borers that affect trees in public parks and in streets of large cities. A number of borers of this class, among which are the imported willow curculio, bronze birch borer, and European leopard moth, are rapidly spreading as pests, and some of the introduced tree defoliators, for example, the gipsy moth and brown-tail moth, are engaging the attention of economic entomologists in the Eastern States. Owing to the increasing correspondence on these insects, the preparation of a popular work covering the principal shade-tree pests not treated in previous publications has been begun, and will be published as soon as feasible.

A detailed account of the leaf-mining locust beetle, one of the worst insect enemies of the black locust, has been prepared, and will soon be published.

By the request of the Bureau of Forestry a popular article on the principal insects which affect the willow is being prepared, to be published in a bulletin by that Bureau as a portion of a consideration of the osier willow.

INVESTIGATIONS ON INSECTS INJURIOUS TO TRUCK CROPS.

Investigations begun in previous years on destructive insects affecting vegetable and other truck crops, including small fruits, was continued during the year. An extensive and valuable report on the subject of the principal insects that have recently been injurious to vegetable crops has been prepared by Mr. Chittenden, and issued as Bulletin No. 33 (new series). Among the insects considered are species which affect cabbage and other crucifers, the list including besides many very destructive forms, a new cabbage looper, a new root-louse affecting the same plant, and a flea-beetle not previously identified with attack on cabbage. The results of observations on the more injurious insects affecting late cabbage point out the value of cleaner farming methods. A number of insects injurious to beans, peas, and other leguminous food crops were given considerable attention, and the new facts discovered in the life histories of some of them are of value in suggesting means of control.

Several insects affecting sugar and table beets have recently come under notice, including a destructive leaf-beetle that has hitherto not been much studied.

The potato-stalk weevil has been given considerable attention, and it has very recently been ascertained that a related species injuriously affects tobacco in Texas, and a third attacks and injures that crop in Florida.

A new insect enemy of carrot and celery attracted attention in New York State, this being the first time that it has been known in injurious numbers in the United States, although it has been present in Canada for some time. It is an important pest, and will probably in time become a serious drawback to the cultivation of the plants mentioned, as well as parsnip and other umbelliferous crops.

Numerous injurious flea-beetles were the subject of special study, as were other insects affecting several vegetables. Among the latter is an asparagus miner which injures the stalks of that plant.

Many of the more injurious insect enemies of small fruits have recently attracted attention and have been studied. The list includes the brown strawberry spanworm, all of the more destructive leaf-rollers, the raspberry gouty gall, the strawberry weevil and root-worms, and certain species of false worms, or "slugs," the larva of sawflies, which affect the same and related plants.

WORK ON THE MEXICAN COTTON BOLL WEEVIL.

The work on the Mexican boll weevil reported in 1901 has been continued, and has the present season been very greatly increased by the liberal appropriation of Congress for the purpose, $20,000 being specifically appropriated for the boll-weevil investigation. The work during the winter and the present season has been given a very practical status. In other words, two field demonstrations are being conducted on cotton plantations of 200 acres and 125 acres, respectively, under the control and direct management of agents of this Division, to demonstrate that by proper methods the damage from the boll weevil can be so reduced as not to be a serious menace to the production of this important staple in the region in Texas already invaded by the weevil. The spring and early summer operations on this plantation are most promising, and we hope that an important demonstration of this kind will have a decided effect in influencing planters generally in Texas to follow the methods which earlier study and experimentation of this office have demonstrated to be effective. This investigation is one of very great importance on account of the probability of the ultimate future spread of the Mexican boll weevil into the adjoining cotton State of Louisiana, and thence across the cotton belt east of the Mississippi. Fortunately, so far it is still confined to Texas; but it will probably be impossible, in view of its wide range in Texas, to prevent its ultimate spread eastward. It is therefore capable of becoming one of the most destructive insects in America, and the investigation will be carried on the present year and continued with the full realization of the importance of the subject.

WORK ON THE CODLING MOTH IN THE NORTHWEST.

The work done on the codling moth in the Northwest on the lines given in the report of 1901 has been continued with very satisfactory results. A preliminary report of this work has been made in Bulletin No. 30 (new series) of this office, and more detailed account is now going through the press as Bulletin No. 35 (new series). The work the present year will be of a very practical character. Demonstration work is now being conducted to show that it is possible to prevent much of the damage which is now annually suffered from the codling moth.

WORK ON INSECTS INJURIOUS TO STORED PRODUCTS.

Insects of this class appear to be increasing their ravages. The Mediterranean flour moth, which is in many respects the most troublesome of all insects that affect stored cereals, and is particularly harmful in flouring mills, was reported as present and injurious in mills in new localities in California, and in Michigan, Wisconsin, and Minnesota.

The Angoumois grain moth has also increased in injuriousness in numbers of States, and particularly northward and in California.

The cigarette beetle has been very injurious during the past year, and was still more destructive the past season. As a result of frequent inquiry for remedies, thorough investigations were conducted by an assistant of this office with the bisulphid of carbon, and so much of value was learned that the results were incorporated in an article on the subject and a Farmers' Bulletin for general distribution.

An exotic cabinet beetle (*Dermestes cadaverinus* Fab.) made its appearance in abundance in silkworm cocoons from China, and did much injury to silk in New Jersey. It also caused much damage to domestic tanned leather, its presence in a warehouse in New York City being traceable to the introduction of foreign hides. It seems probable that it has obtained a foothold in this country, but it can be exterminated with the cooperation of all who are troubled by its ravages. In the treatment of all of the insects which have been mentioned, and others which affect stored produce, the bisulphid of carbon remedy has been usually employed; but recently experiments have been made with hydrocyanic-acid gas, and it may be that this remedy will in the course of time be found to be more valuable in the treatment of many such insects, except with seed material.

WORK ON INSECTS AFFECTING GREENHOUSE AND OTHER ORNAMENTAL PLANTS.

Work begun in previous years on this class of insect pests has been continued. Several species affecting roses, hitherto not known as noxious to this plant, have been under particular observation. Several species of thrips have been unusually numerous, and some work has been done on them, more especially with remedies. An insect known as the bulb mite, which attacks living healthy tissue and aids in the spread of diseased conditions, has caused great damage for a number of years in greenhouses to bulbs, as lily, orchid, and amaryllis. It has lately been ascertained that this insect prevents the union in grafts of pecan, hickory, and other nut trees.

WORK ON INSECTS INJURIOUS TO CITRUS TREES AND FRUITS.

The article on the citrus insects published in the Yearbook of this Department for 1900 and based in part on investigations made in California in the summer of that year is about to be issued as a Farmers' Bulletin, to give wider currency to the information contained and to be more available as a means of answering the constant requests for information on the subject covered. In his explorations of Japan and China the writer gave special attention to the insect enemies of the citrus fruits grown throughout central and southern Japan and southern China, the British Straits Settlements, and Java, collecting and determining the common scale pests and other insect

enemies of these plants in the countries named. The general report on this trip will contain a description of the citrus enemies discovered and studied, and will have a special importance in view of the greater likelihood of the importation of citrus stock from the countries named in future on account of our closer political relations with them.

WORK ON INSECTS IN THEIR DIRECT RELATION TO THE HEALTH OF MAN.

The question of insects as conveyers of disease to human beings, and more particularly in the rural districts, has been the subject of special research for the past three years. A popular article by Dr. Howard on this topic was published in the Yearbook for 1901, and, owing to the great demand for information on this subject, this article was republished as a Farmers' Bulletin. Since its issuance in the latter form an average of between 20 and 30 letters per day have been received requesting information on this subject and were answered by the bulletin mentioned. This work covers more particularly the insects concerned as carriers of malaria, in which certain mosquitoes play the most important rôle, and typhoid fever, which is disseminated by the house fly and related insects. The more important insect transmitters of disease have been studied or are under investigation, but we are in frequent receipt of material from this and other countries which shows that there are still many insects which require study, and this work will be prosecuted actively in the future.

UNCLASSIFIED WORK ON INJURIOUS INSECTS.

During the last fiscal year investigations were taken up on supposed insect damage to the cocoanut-palm industry in Cuba. More recently we have had considerable correspondence with persons largely interested in the growing of these palms in Florida and in British Honduras. As a result, an article has been prepared on the principal insects which act as disseminators of the trouble which is locally termed "fever," and which appears to be due to a fungous disease. It includes valuable suggestions based on reports received from practical growers as to the best methods for the prevention of the dissemination of the disease.

In the fiscal year which ended June 30, 1901, a popular account of the principal insect enemies of growing wheat was published, and during the same year an extensive account of two very destructive insects which affect cereal and forage as well as truck crops (the fall army worm and the variegated cutworm) was completed and made public. Certain minor insects which attack cereals have been taken up in connection with other work, the list including the very injurious corn root-worms, the lesser corn stalk-borer, and a species of corn bill-bug new to science. An extensive account of the Southern grain louse (*Toxoptera graminum*) which was destructive in Texas to wheat and some other cereals the same year, was prepared and is now ready for publication. A field agent of this office has been engaged to investigate some of the insects which injuriously affect the stems of the small grains. Little of this work, however, has been done during the present fiscal year, and the above brief mention of the facts is sufficient for present purposes.

Some investigations were conducted with a view to the ascertaining of methods of control for certain insect enemies of mushrooms, and a report on this subject is available for publication.

Another very important line of work is the maintenance of records of the feeding and other habits of injurious insects received from correspondents, field agents, and others, and which are sent in for identification and for information in regard to the best means of control. It is frequently found necessary, that we may judge of their status as pests and be better able to indicate the most vulnerable point of attack, to rear these insects, and, where possible, to ascertain their full life histories from egg to adult. During the fiscal year 226 species not hitherto studied at this Department were given more or less study, and the catalogue number of our biological series thus studied now reaches 9,667, this number being the accumulation from 1881 to date.

A prominent feature of this work is the preparation of material obtained from various sources for purposes of exhibition, for permanent storage in the United States National Museum, for exchange with other institutions in this and other countries, and for illustration and description. When insects that have not hitherto been studied or are imperfectly known are obtained in their different stages, illustrations are prepared for use in the preparation of articles on them.

EXPERIMENTAL WORK WITH INSECTICIDES.

During the year a considerable number of experiments with insecticides and other methods of controlling insect depredations have been conducted. A great many insecticide substances are constantly being exploited in advertising columns of journals and papers, and many of these come to this office for experimental examination and test either from purchasers or the manufacturers. Most of these are of very little value, or are combinations of old and well-known insecticide substances, sold, however, as a rule, under their new form at quadruple or many times their real value. The cooperation of the Chemist of the Department has been often asked to determine the composition of these substances. The necessity of work of this sort having been frequently brought to his notice, the Chemist has established a special section for insecticide analysis and investigation in cooperation with the Division of Entomology, and during the year a large series of examinations of common insecticide substances has been made from materials collected, for the most part in open market. We have been assisted in the purchase of material by the entomologists of various experiment stations and by private individuals, the effort having been made to get the insecticide materials over a wide range of country, so that the analysis would represent material under the identical conditions in which it would be purchased by the farmer or fruit grower.

To determine the feasibility of eradicating household insects by fumigation with hydrocyanic-acid gas, several valuable experimental operations have been conducted with the result of the establishment of the complete practicability of disinfecting houses by this means. The latter has already been given considerable publicity in the daily press, and the methods are fully detailed in Circular No. 46 (second series) of this office. It has been demonstrated that this poisonous gas can be used without risk to human life if the operation is carried on with proper precautions, but no one is advised to undertake it without having fully acquainted himself with the steps in the process as indicated in the publication cited.

WORK ON THE GEOGRAPHICAL DISTRIBUTION OF INJURIOUS INSECTS IN THE UNITED STATES.

During the past fiscal year it has been learned that a number of insects have been introduced in this country, and in reports which have been published in regard to them their distribution abroad and their present habitat in this country have been carefully defined, and from this data the probable future spread has been indicated. The work of mapping the distribution of the most destructive native as well as introduced species has been continued. This is a work that will require considerable time before its final completion. Meanwhile a careful record is being kept of reports received from correspondents and from experiment station entomologists and other practical workers throughout the country, so that data are available when desired on the known distribution of any prominent injurious species. From time to time inquiries are made in regard to these matters from various practical economic workers, and our lists are found indispensable for the purpose.

APICULTURAL INVESTIGATIONS.

In apiculture the work included an importation of select breeding queens from Italy and smaller importations from Austria and Cyprus. These were forwarded to experiment stations and to bee raisers in different sections of the country. Favorable reports have been received, notably in the case of a southern California bee keeper whose honey crop during the year was 38 tons. He stated that while black bees were doing nothing the Cyprians from the Department importation gathered a fair crop, while the best Italians of his own raising got only half as much. Various crosses were made between these races and some promising strains secured, one result being that the irritability of some excellent honey gatherers can be modified by using males of gentler races in the crosses. Further data regarding honey-producing plants, their distribution, times of blossoming, and amounts and qualities of the yield have been collected. Practical tests of various systems and devices for rearing queen bees have been made. In this connection a queen-rearing nucleus hive, which promises excellent results, both in the rearing of queens and the wintering of surplus queens, has been devised. Experiments in connection with outdoor wintering were also repeated.

TECHNICAL WORK.

Nearly all of the various expert employees connected with this office are specialists in certain orders or smaller groups of insects, and are obliged each year to devote much time to the identification of specimens for experiment station entomologists and others throughout the country, and even abroad, who have not access to libraries or large collections. This work is carried on mainly through correspondence, and, as indicated in previous reports of the Entomologist, makes practically no showing in the output of the Division. It is, however, a necessity, and of great practical value in facilitating the work of those who need such assistance before they can write or publish understandingly with regard to the destructive insects which they have under observation. Mention has been made under the title of "Work on scale insects" of the determinations of material in that group of insects.

A group of injurious mites containing about 20 species, the Tyroglyphidæ, has been the subject of special study by one of the office experts, and a report will be available in a few months, to be issued as a bulletin of the technical series of this Division. Nearly all of these insects have been introduced from Europe, and are for the most part very minute in size, and have required very careful study for their identification and separation into species. They attack principally stored products, both animal and vegetable, such as cheese and ham and various seeds, and are frequently pests in granaries, warehouses, flouring mills, and similar buildings where perishable material is stored. One of these, worthy of particular mention, is an enemy to figs and prunes, dried and while drying, and has recently been discovered in California. Another, the bulb mite, has been already mentioned in the consideration of work on greenhouse pests. Still another species is a serious mushroom pest, while others injure the roots of various plants. As a rule, these insects affect plants propagated under artificial conditions, and are more abundant on plants of weak growth. The species which affect stored material can be successfully treated by fumigation with bisulphid of carbon or hydrocyanic-acid gas, but as yet no practical economic treatment has been devised for some of the forms which affect living plants.

BIBLIOGRAPHICAL WORK.

The preparation of indexes to the more important contributions on American economic entomology has been continued as in previous years; and Part VIII of a series covering this subject will, it is expected, be ready for publication by January 1, 1903. There is now in process of publication an index to the first thirty general bulletins (new series) of this office.

CORRESPONDENCE.

The correspondence for the fiscal year ended June 30, 1901, was greater than ever before in the history of the Division, necessitating the writing of about 8,500 letters in answer to inquiries regarding noxious insects, in addition to others that were answered by circulars, printed or mimeographed. To reduce the number of letters to be answered by dictation, we have prepared and published during the year eight circulars and five Farmers' Bulletins. Nevertheless, about as many letters as written the previous year were sent out, and the answering of correspondence by circulars has also greatly increased, demanding at the present writing nearly the entire time of one clerk of this office. The work of preparing additional circulars is being continued, and it is planned that at least an equal number of publications of this nature and Farmers' Bulletins will be issued during the coming fiscal year.

PROPOSED WORK FOR THE FISCAL YEAR 1903.

The work for the fiscal year of 1903 will be a continuation of the investigations, described in the foregoing pages, now in progress. The important boll-weevil work in Texas will be especially developed along the lines of practical field demonstration. The opportunity, however, will offer in the fall, when the season's work in the field is over, to make some very desirable explorations in Mexico, which will occupy the attention of two of our special agents; and important biological

and life-history studies will be made in Texas, the present range of the insect carefully mapped, and the means of possibly checking its further spread determined. The work with the codling moth in the Northwest will be continued in accordance with present plans, and will be made the subject of a special report, which will be published as a bulletin of this office. The special work with the grasshopper fungus will be continued through the summer, and if results warrant will be given a further test next year to fully determine its value. The many lines of work with foreign insects and importations will be extended and continued. No effort will be omitted to establish and disseminate the Asiatic enemy of the San Jose scale. The cooperation of the leading experiment stations throughout the country has been promised, and the beetles have multiplied to such an extent in the breeding cages on the Department grounds that it has already been possible to begin sending out batches to station officials. These beetles will be sent to many places in the Eastern United States this fall and given careful attention during the autumn and winter, and the work of spreading this useful beetle will be continued the following summer. In the same way the Austrian ladybird enemy of plant lice will be sent out in batches to different States this fall, and will be followed up by similar work the following year. The same may be said of the other parasitic enemies which we are attempting to establish in California for the benefit of fruit growers. New work of this kind will also be taken up, special attention being given, among other things, to the European enemies of the gipsy moth and the brown-tail moth. The great interest aroused throughout the country in mosquito investigation and methods for their extermination will be taken advantage of to encourage communities everywhere to take hold vigorously of this problem. Assistance will be rendered by this office, by advice and the sending of published descriptions of methods and by personal inspection where feasible and necessary. The rôle played by these and other insects as conveyers of disease, which has been under investigation for a number of years past, will be continued, its importance demanding for it all the time and force available. The general work of investigation of insect enemies of grains and fruits will be continued, covering both the cereals of the Northern States and the crops especially appertaining to the South, such as sugar cane, cotton, rice, and tobacco.

The general subject of insects affecting vegetable crops will be investigated from time to time on the line of work that has been done in past years under this head. As soon as certain observations which are now under way on the life histories of certain insects affecting asparagus are finished, a popular account, as complete as possible, will be prepared on all insects of this class. This work will be followed, it is planned, by a similar consideration of the principal insect enemies of beans, peas, and other edible leguminous crop plants. Some of the insects which attack cabbage and other cruciferous crops, and melons, squashes, and other cucurbits, are extremely difficult to combat. Arrangements have therefore been made to carry on experiments looking toward better means of controlling some of the more important insect enemies of these two classes of vegetable crops. New insect enemies of truck crops are constantly being discovered and will be studied as opportunity offers and necessity requires. Insects which attack small fruits will be studied, as in previous years, and experiments will be undertaken to devise new methods of controlling them.

The work for 1903 on the insect enemies of forest and forest prod-

ucts will be continued. The special new investigations which it is proposed to undertake are a study of the insect enemies of Eastern, Southern, and Western pine forests, to determine if possible the primary causes of the serious insect damage now being done to pine timber of the western sections of North Carolina and South Carolina, northern Georgia, southern Florida, the white pine or silver pine of northern Idaho, the Monterey pine of California, and the pines of Arizona and Colorado. It is proposed to have the regions designated given a preliminary survey to determine existing conditions and then to establish in favorable sections assistants to carry on experiments and make special observations. This work will be done in cooperation with the Bureau of Forestry. It is expected that by the close of this year it will be possible to have a report ready for publication on the principal pine insects of North America, which will include brief popular descriptions of the more important insects, with illustrations and recommendations for preventing losses.

The shade-tree insects which have been mentioned in the portion of this report on the work conducted during the fiscal year 1902 will undoubtedly increase their range in coming years as they have in the past, and we anticipate great trouble from them. These species are the gipsy moth, brown-tail moth, and perhaps the elm leaf-beetle, which is gradually spreading westward and southward, the European leopard moth, the bronze birch borer, and the willow and poplar curculio. Some of these boring insects can be treated successfully, but others are difficult to combat and can not be reached by means of insecticides. Such being the case, experiments will be necessary for new methods of controlling them.

Among insects which affect ornamental plants, those which injure roses grown out of doors and under glass will be made the subject of special study, and a popular publication on these pests is in course of preparation.

Such thorough investigations have already been conducted on insects which affect stored cereals and similar food products that it is not anticipated much study will be necessitated in this line; but there is one pest, the Mediterranean flour moth, which may sooner or later demand further attention, as it is rapidly spreading. It is perhaps only a matter of a few years when it will be found in all of the principal cereal-producing States in this country, if indeed it has not already reached them.

It is proposed the next year to endeavor, in cooperation with the Division of Statistics, to collect statistics regarding the yield of honey in sections, in order to furnish crop reports which shall aid in steadying prices of apiarian products. Further importations of valuable races for testing will be made. An experiment in the mating of queen bees in confinement has been devised and will be carried on. The rapid extraction of honey from combs is a great desideratum in large commercial apiaries, and it is thought that experiments may develop a method of facilitating this. In former years artificial queen cells readily removable for insertion in queenless colonies have been devised and experimented with. It is proposed to determine by a final test the best material to be used as a commercial aid to queen breeders. The extra early rearing of queens and drones will be made the subject of careful experiment.

The silk investigations authorized by the last Congress have already been commenced. Miss Henrietta A. Kelly has been employed as special agent in silk culture in the South, and is charged with the

preparation of a manual of instructions which it is expected will be ready for publication and distribution this fall. She will also look over the ground and select suitable locations for model silk plantations and rearing establishments which may serve as schools of instruction, where interested persons and others may come and acquire familiarity with all the steps in the care of caterpillars and the handling of cocoons. The Entomologist, Dr. Howard, in his European trip, is giving special attention to the silk industry of Southern France and Italy, studying especially the methods of reeling silk and silk manufacturing establishments. He will also arrange for the purchase of "seed," or silkworm eggs, which can be relied upon as free from disease, and also negotiate for the importation of mulberry stock.

PLANS OF WORK RECOMMENDED FOR 1904.

By the organization of the work in entomology of the Department of Agriculture on the lines of a bureau, as indicated for this year, it is expected to very largely extend and develop the practical work being done in the study of injurious insects. The work of this Division has grown very rapidly during the last few years, but is capable of very much greater development. An organization on the lines of a bureau is already in practical operation, the work of the office being divided into a number of distinct departments, in various instances receiving specific appropriations. The plan of the new organization indicates the subdivision of the work in entomology which it has been decided to make. Many important fields of investigation have remained unworked in the past for lack of funds and expert assistance. If the plans made for the bureau organization meet with approval and receive the sanction of Congress, it is proposed to prosecute work over the whole field of applied entomology in America, as described under the different sections of the classification recommended.

ORGANIZATION OF WORK IN PROPOSED BUREAU OF ENTOMOLOGY.

The following is the plan of organization of work in the proposed Bureau of Entomology:

Field crop insect investigations:
- (*a*) Southern section—cotton, tobacco, sugar cane.
- (*b*) Northern section—cereals and forage plants.

Fruit insect investigations:
- (*a*) Northern section—orchard fruits, deciduous.
- (*b*) Southern section—citrus and other tropical fruits.

Small fruit and truck crop insect investigations.
Forest and forest product insect investigations.
Insecticide and insecticide machinery investigations:
- (*a*) Section of field operations and experiments.
- (*b*) Section of chemical analyses and tests.

Investigations of insects affecting stored products.
Investigations of insects in relation to disease of man and animals, and as animal parasites.
Special insect investigations—miscellaneous work:
- (*a*) Section for the investigation and introduction of beneficial insects, and quarantine work.
- (*b*) Section for fungous and other diseases of insects.
- (*c*) Section for special insect investigations—emergency work and unclassified.

Insect laboratory, collections, and experimental garden.
Apicultural investigations.
Sericultural investigations.
Librarian and bibliographer.

FIELD CROP INSECT INVESTIGATIONS.

It is proposed to make two sections for this work:

(*a*) A Southern section will have special charge of the insect enemies of cotton, tobacco, and sugar cane, and will include the work now being done under the specific boll weevil appropriation. The boll weevil work will be carried on in the same general lines now in progress for 1903. The agents engaged in the cotton boll weevil work can, however, from time to time, make studies and achieve valuable results with other insect enemies of cotton, and also of the other Southern staples mentioned.

(*b*) A Northern section will be devoted to the study of insect enemies of cereals and forage plants, a field of the greatest importance, which heretofore we have been able to cover only in a very fragmentary way by the occasional employment of special field agents to make investigations of particular insect pests of such plants. We hope to employ an expert investigator who shall devote his entire time to this field of inquiry, and to equip him with sufficient assistants and funds to carry out desirable investigations.

FRUIT INSECT INVESTIGATIONS.

Two sections are recommended for this field of inquiry:

(*a*) A Northern section relating to the deciduous orchard fruits, which shall include the work now being done in the Northwest on the codling moth, and in addition work on all the other insect enemies of the apple, as well as the other deciduous fruits of America.

(*b*) A Southern section devoted to the study of the insect enemies of citrus and other tropical fruits. This last field, formerly a very important one in the entomological work of the Department, has been practically neglected for several years, with the exception of the investigations made in California by the writer in 1900. It is desired to have a capable expert take charge of a continuous investigation of the insect enemies of all subtropical and tropical fruits, and give such direction and superintendence to work in the new tropical possessions as shall be required of this office. The importance of the subjects warrants the devotion of a sufficient sum to this work to enable practical field investigations to be made and the publication of the results in the form of bulletins and circulars.

SMALL FRUIT AND TRUCK CROP INSECT INVESTIGATIONS.

This field of investigation has been actively covered in the past by this office, but it is possible to very much extend the work by placing it more directly under the control of the present expert in charge, and make it possible, by the establishment of larger experimental grounds, to carry out the investigations systematically and over the entire field. Among the special subjects on which investigations will have to be made in the near future are the insects injuriously affecting the sugar beet, a work that is necessary on account of the rapidly growing importance of this industry.

It is intended during the year 1904 to complete investigations which have already been carried on for a number of years on certain of the most destructive and troublesome insects affecting small fruits, particularly strawberries, blackberries, raspberries, and some similar crops.

FOREST AND FOREST PRODUCT INSECT INVESTIGATIONS.

These investigations have already been established as a separate section, working in cooperation with the Bureau of Forestry. In the new organization it is hoped to add to its efficiency by arranging for an additional field assistant and for an office assistant. The work outlined for 1903 will be continued, and special new work for the year will be taken up in the study of the oak and spruce insects with the view of publishing a report toward the close of the year. Any exceptional insect outbreak in forest areas will be subject to prompt investigation.

INSECTICIDE AND INSECTICIDE MACHINERY INVESTIGATIONS.

It is proposed that this section shall cover the entire field of practical experimentation with insecticides and insecticide machinery. The detail of a chemist from the Bureau of Chemistry, to take charge of the analyses and tests, is planned, and it is proposed to provide an expert to work in cooperation with the Chemist to carry out the field operations and experiments on growing trees and vegetables. The enormous increase in the employment of insecticides in the last few years calls for very much more extensive investigation on the part of this Department than it has hitherto been possible to give to the subject. The very great use of petroleum oils especially demands a constant supervision of the oil products used for insecticides, some of which are very injurious to plants and others harmless. The demand for a thorough investigation of this field by the Department of Agriculture is voiced by the resolutions recently passed at the summer meetings of the Society for the Promotion of Agricultural Science and of the Association of Economic Entomologists. The proposed change will bring all the insecticide investigations of the Department under one office, and facilitate and give a much more practical bearing to the work than has been heretofore possible.

INVESTIGATIONS OF INSECTS AFFECTING STORED PRODUCTS.

A good deal of work has already been done under this head, but it is proposed, by making this a special section, to very much extend the work and give it a more practical bearing, undertaking experiments to determine in a practical way, in granaries and large warehouses, mills, and other establishments, the value of the means of protecting stored products. It is proposed in this section to include the study of the insect enemies of preserved animal and vegetable food substances, as well as the cereal products, and also materials and fabrics of all sorts.

INVESTIGATIONS OF INSECTS IN RELATION TO DISEASES OF MAN AND ANIMALS, AND AS ANIMAL PARASITES.

It is wished to very much extend the considerable work already done in this field. For this purpose, it is proposed to establish for it a special section. It will include, in the case of the domestic animals, all of the internal parasitic flies, and the external parasitic insects, and the biting flies, such as the horn fly, gadflies, buffalo gnats, etc.; in the case of man and animals, the important rôle of insects as conveyers and disseminators of disease. A very capable assistant will be required to take direct charge of this work.

SPECIAL INVESTIGATIONS.

Under this head is classified the investigation and introduction of foreign beneficial insects, a subject which has assumed in recent years very great importance. The supervision of quarantine operations will also come in this section, as well as the propagation and distribution of fungous diseases of insects and the general investigation of this important subject. For this work it will be necessary to secure the services of two high-grade experts, one to have charge of insect introductions and quarantine, and the other to be an insect pathologist. Relative to the last, it may be said that this office has been able to carry out its work with insect diseases only through the courtesy and with the material aid of the Bureau of Animal Industry and experts in other offices of this Department. This work is of sufficient importance to demand the appointment of an expert who shall be able to devote all his time to the subject. The artificial use of contagious insect diseases to control insect pests is a field which is constantly demanding investigation, and its importance perhaps is much greater than has been hitherto realized.

INSECT LABORATORY AND EXPERIMENTAL GARDEN.

A small and very inadequate experimental garden is now attached to the insectary of this Department. It is proposed to secure a larger tract for the establishment of an experimental orchard and garden in connection with the Washington office, to facilitate and give a practical feature to the local breeding and insecticide operations. This will necessitate the employment of a gardener and laborer.

APICULTURAL INVESTIGATIONS.

In apiculture, it is proposed to specially investigate the subject of artificial pasturage, which hitherto has not received the attention it deserves. A series of experiments will be entered upon to determine what crops may be profitably employed to fill the gaps in the honey yield, or to create artificial pasturage for apiaries, and an effort will be made in this connection to introduce honey plants from abroad. It is proposed to import and test various races or species of bees that are now little or not at all known in this country; for example, the race native to the Caucasus and those found in Dalmatia, Austria, and notably the large bee of the East (*Apis dorsata*), to be obtained from the Philippine Islands. The breeding of crosses will be continued, and the collection of statistics is proposed.

SERICULTURAL INVESTIGATIONS.

It is desired to make this a special section of the entomological work of the Department. To carry out the investigations increased appropriations are desired. For the year 1904 it is the intention to follow up the work outlined for the year 1903, to establish and equip experimental stations in the South, to enter into cooperative work in silk raising with some of the agricultural experiment stations which have expressed the wish to assist us in the investigation of silk culture, and to establish in the city of Washington or elsewhere a practical reeling plant, so that the silk cocoons produced in small quantities can be purchased and reeled and the product marketed.

REPORT OF THE CHIEF OF THE DIVISION OF BIOLOGICAL SURVEY.

U. S. Department of Agriculture,
Division of Biological Survey,
Washington, D. C., October 9, 1902.

Sir: I have the honor to submit herewith a report of the work of the Biological Survey for the fiscal year ending June 30, 1902, with outline of work for 1903, and recommendations for 1904.

Respectfully,

C. Hart Merriam, *Chief.*

Hon. James Wilson, *Secretary.*

WORK OF THE YEAR.

As heretofore, the work of the Division has been conducted along three lines: (1) Investigations relating to the geographic distribution of animals and plants, including biological surveys and the determination of the life and crop belts, in charge of the chief; (2) investigations of the economic relations of birds to agriculture, in charge of Prof. F. E. L. Beal; (3) supervision of matters relating to game preservation and protection and the importation of foreign birds and animals, in charge of Dr. T. S. Palmer.

FIELD WORK.

Field work in studying the geographic distribution of mammals, birds, and plants, and in investigating the depredations of prairie dogs, has been carried on over wide areas in California, Texas, Kansas, Nebraska, the Dakotas, Montana, New Mexico, and Indian Territory. Extensive work also was done in Mexico and in the Canadian provinces of Alberta, Athabasca, and Mackenzie.

California has unusual claims on the Biological Survey. The diversity and commercial value of its agricultural products—its preeminence as a fruit-growing State, the extent of its grain fields, sugar-beet lands, and stock ranges—demand the early completion of maps showing the courses of the life zones and crop belts within its borders. But the preparation of these maps is unusually difficult on account of the extraordinary diversity of the physical and climatic conditions. Not only are there torrid valleys below the level of the sea, and alpine summits towering to elevations of more than 14,000 feet, but there are also areas of excessive humidity—of frequent fogs and heavy rainfall—and areas of excessive aridity—hotter and drier than the Sahara, where perpetual sunshine is the rule and years sometimes pass without rain. The labor of tracing the boundaries of the life

zones, therefore, is one of great detail, and is made still more difficult by the absence of accurate topographic base maps, except of the areas already mapped by the United States Geological Survey. For some years the Biological Survey has been at work in California, doing as much each year as its limited means have permitted. During the past season sections were studied on both slopes of the Sierra Nevada—from Mono Lake to Owens Valley on the east, and from Kaweah River to the Tuolumne on the west—and in Riverside and San Diego counties, by parties in charge of the chief of the Division. The field parties in Texas, in charge of Vernon Bailey, chief field naturalist, visited, among other localities, the Chisos, Davis, and Guadalupe mountains, the forested swamps of Sabine River, and the open Staked Plains. The work in the Guadalupe Mountains was extended into New Mexico, where parts of the Pecos Valley and Sacramento Mountains were studied. As in previous years, the field work in Mexico was in charge of E. W. Nelson, and investigations were carried on in the States of Tamaulipas, Nuevo Leon, and Coahuila, where much valuable material was collected. The exploration of the Great Slave Lake region in Canada, which was barely commenced in the latter part of the last fiscal year, was carried to a successful termination by Edward A. Preble. Much important information was obtained and extensive collections were secured. As on his previous trip to Hudson Bay, Mr. Preble was heartily welcomed and given substantial assistance by the officers of the Hudson Bay Company. Without this cordial cooperation the expedition might easily have failed.

In the Great Plains region prairie dogs have greatly increased, owing to the extension of ranching and the destruction of their natural enemies. Their depredations are widespread, and complaints and requests for assistance have come to the Department from hundreds of localities. In order to obtain accurate information, an assistant, Wilfred H. Osgood, was sent to Kansas, Nebraska, North Dakota, South Dakota, and Montana to examine the conditions and to experiment with bisulphide of carbon and other poisons with a view to finding some cheap as well as effective remedy against this pest. Similar investigations were carried on in Texas by Vernon Bailey and H. C. Oberholser, but lack of funds prevented field experiments in poisoning in winter and early spring, when poisons are most freely taken. The present status of the subject is summarized in a paper by the chief of the Division on "The prairie dog of the Great Plains," in the Yearbook of the Department for 1901.

ECONOMIC ORNITHOLOGY.

The work of the economic section during the fiscal year ending June 30, 1902, as in previous years, has consisted of two distinct parts—laboratory work and field work. Laboratory work consists in the examination of stomachs and crops of birds and the tabulation of results. Field work consists in observing the food habits of birds in the field to learn as fully as possible upon what certain species feed, where they feed, and when they feed, and also what foods are most abundant and most easily procured; in other words, to observe every circumstance connected with the food habits, so as to ascertain if possible whether apparently favored food is eaten through preference or necessity. During the year there have been received from miscellaneous collectors 3,972 stomachs of birds. In addition to these, Prof. S. A. Forbes, of Champaign, Ill., has presented to the Biological

Survey his collection of a little more than 5,000 stomachs. Thus, about 9,000 stomachs have been added to those now in stock, making the total number on hand a little more than 45,000.

During the year there have been examined 2,234 stomachs, distributed among various groups as follows:

Ducks	31	Fringillidæ	546
Woodcock	20	Shrikes	43
Gallinæ	966	Wrens	44
Woodpeckers	41	Titmice	27
Flycatchers	155	Thrushes	97
Jays	144	Miscellaneous	55
Horned larks	21		
Icteridæ	44	Total	2,234

A bulletin on the food of the sparrows, by Sylvester Dwight Judd, has been published. Its preparation occupied three years, and involved the examination and tabulation of more than 4,000 stomachs, besides a large amount of field work. It is believed that the results are of interest and value to farmers throughout the land. For several years Dr. Judd has also been studying the birds on a Maryland farm, which he has visited for this purpose at frequent intervals and at all seasons. The farm selected is one yielding a diversity of crops, and is believed to be as nearly typical as could be found within convenient distance from Washington. In pursuance of this work, Dr. Judd has carefully studied the food of every species of bird on the place, as well as could be determined by field observation, and at the same time has noted the quantity and character of the visible supply of bird food. He has observed the birds not only at all seasons of the year, but at all hours of the day and in all conditions of weather and temperature, and has also taken specimens at various times in order to examine the contents of their stomachs. The object in view has been to find out the relations and interactions of birds and insects upon farm crops; to ascertain if any direct checks upon the ravages of insects through the actions of birds are noticeable, and to judge as nearly as may be what damage is done to crops by birds themselves, and to what extent this damage is offset by useful services rendered.

For many years the fruit growers of California have been complaining of the destruction of fruit by birds. In order to gain definite knowledge upon this subject, Prof. F. E. L. Beal visited California in May, 1901, and remained there nearly four months studying the conditions that prevail in the great fruit-growing sections. During this time he visited some of the principal fruit-raising centers and studied the habits of birds in the orchards when the fruit crop was at its best. Incidentally, he traveled nearly 3,000 miles within the limits of the State, and interviewed many of the principal fruit growers, who courteously extended every facility for his investigations. He collected more than a thousand stomachs of birds, mostly taken in orchards when the fruit was ripe, and also such of the common insects, seeds, and wild fruits as were deemed likely to serve as food for birds. Since his return the stomachs have been examined, together with others previously received from collectors in California.

In view of the great interest now taken in game protection, a study of the food habits of game birds is of pressing need. It is desirable to ascertain the true economic position of the different members of this group in order to determine to what extent their preservation is demanded by reasons other than those founded upon their value as

food or the desire to kill them for sport. Accordingly, during the past year, Dr. Judd has been pursuing such investigation. He has now in view a bulletin on the food of the Gallinæ, and will include with these the woodcock as a bird of special interest from the fact that owing to the high esteem in which it is held as an article of food, and the lack of adequate laws for its protection, it is fast vanishing from the earth. This work is well advanced and may be expected at an early date. Bulletins on the food of waterfowl and shore birds are in contemplation, and some work has already been done in these groups.

PROTECTION OF BIRDS AND GAME.

During the year work under the Lacey Act has been continued along three main lines—(1) publication of information on game protection; (2) improvement of the inspection service connected with importation of foreign birds and animals; and (3) cooperative work in restricting interstate shipment of game contrary to law.

PUBLICATIONS.

The compilations and synopses of game laws issued from time to time have been distributed widely, and are in constant demand. With a view to making the ever-changing provisions of the State laws better known, a digest of the game laws for 1901 and two posters showing close seasons in the United States and Canada were distributed in September, about the beginning of the hunting season. A revised edition of the laws protecting nongame birds was published later. Circulars were also issued containing the game laws of the District of Columbia, regulations for importation of reptiles into Hawaii, and for the introduction of the eggs of game birds into the United States. The annual directory of State officials and organizations concerned with game protection was prepared for the Yearbook of the Department and afterwards issued separately. Finally, a popular account of the woodcock and wood duck, by Dr. A. K. Fisher, the first of a series of special papers on game birds, was also published in the Yearbook.

IMPORTATION OF FOREIGN SPECIES.

During the year 287 permits were issued for the entry of about 200 mammals and 50,000 birds, an increase of 101 permits and 43,000 birds, and a decrease of 150 mammals, compared with the transactions in 1901. The figures are, however, subject to revision, as the number of birds actually imported is often less than that called for in the permit. There has been a decided increase in the number of birds entered at New York, while the number imported at San Francisco has decreased, particularly in the case of Australian species. This decrease is attributed to the long-continued drought in Australia and the consequent difficulty in securing birds there. Among the most noteworthy mammals imported may be mentioned a musk ox captured near the mouth of the Mackenzie River and entered at San Francisco. This specimen, the first musk ox in captivity in the United States, is now in the collection of the New York Zoological Society. A number of North African ostriches, the first of this species of ostriches to be brought in for propagation, were imported for the ostrich farm at Pasadena, Calif.

Importations may be divided into two general groups—game birds

imported for propagation in captivity, and birds brought in to supply the trade in cage birds. Of these two classes, the latter greatly exceeds the former in numbers. The consignments of cage birds are often of considerable size, and to prevent any injurious species from entering unnoticed amid a large number of harmless ones, arrangements were made through the Secretary of the Treasury, in July, 1901, whereby all big consignments of cage birds arriving at New York, the main port of entry for birds, were subjected to examination by the inspectors of this Department. Approximately, 200,000 birds, including about 180,000 canaries, were entered at New York, most of which were inspected. The new duties thus created necessitated the appointment of an additional inspector at New York, making three in all now on duty at that port.

On January 1, 1902, the inspection service was extended to the Territory of Hawaii and a special inspector appointed for Honolulu. Owing to absence of cable communication with the islands this inspector has been authorized to issue permits subject to general instructions from the Department. In May, at the earnest request of the Chamber of Commerce in Honolulu and of some of the sugar planters of Hawaii, an order was issued requiring permits for all reptiles imported into the Territory and prohibiting the entry of poisonous species.

Twelve foreign species of mammals and birds are now known to be acclimated in Hawaii, four of which—the mongoose, the English sparrow, the mina, and the Java ricebird (*Munia nisoria*)—are injurious. In Porto Rico the mongoose is acclimated and also two species of African weaver birds, whose exact economic status is not yet known. A few specimens of the mongoose are still in captivity in the United States, but these are, as a rule, in public zoological gardens where their safe-keeping is assured.

So far as known, no prohibited species have been brought into the United States during the year. Entry has been refused in the case of one mongoose at San Francisco and two fruit-eating bats and one kohlmeise at New York. The principal importers of foreign birds and animals have shown no disposition to attempt the importation of prohibited species and have uniformly complied with the requirements of the law.

By an act of Congress approved June 3, 1902, the prohibition against the entry of eggs of game birds which has existed since 1894 has been removed, and these eggs can now be imported, under regulations of this Department, for propagation. The regulations necessary to carry out the law were promptly promulgated, and within a few weeks after the bill was signed the first importation of eggs arrived at New York.

INTERSTATE COMMERCE IN GAME.

The provisions of the law regarding interstate commerce in game have necessarily been carried out very largely through cooperation with State officers. Special mention should be made of the services rendered in this connection by the State game commissioner of Illinois and the State game wardens of Iowa, Michigan, and West Virginia. Through the cordial cooperation of the Attorney-General, the cases referred for action to the Department of Justice have been taken up as promptly as possible and many of them prosecuted to a successful termination. During the year 39 cases, involving the illegal shipment of about 5,000 birds, were reported to this Department, as against 57

cases, involving the shipment of about 16,000 birds, during the preceding year. This decrease in number of cases does not necessarily imply a more careful observance of the law, for it is probable that only a comparatively small number of violations are brought to the surface. The proportion of convictions, however, will probably be larger, for the cases of this year have been supported by much better evidence than those of 1901, and their prosecution is likely to prove much more effective. Of the cases arising this year, only two have been dropped for lack of sufficient evidence, and one is still awaiting action; the others have been referred, 23 to the Department of Justice and 13 to State officers. Four of the State cases have already resulted in conviction. Since the passage of the act 24 convictions have already been secured in cases passing through this Department—14 in the Federal courts and 10 in the State courts; and 30 or more cases are still pending in the Federal courts.

BIRD MIGRATION.

Prof. W. W. Cooke, author of "Bird migration in the Mississippi Valley" (Bulletin No. 2 of this Division, 1886), has been temporarily employed to arrange the material that has accumulated since the publication of the former bulletin. In working out the winter ranges and migration routes it was found that the number of observers in the South Atlantic and Gulf States was insufficient to supply the needed data. Consequently, a large amount of preliminary work had to be done, and at the very beginning an attempt to increase the number of observers in these sections was undertaken. With this object in view about 800 letters were written, resulting in promises of aid and cooperation from over 200 persons, and the actual receipt of nearly six times as many reports as came from these sections in 1901. A bibliography of migration has been undertaken, and is now practically complete, for the years 1845–1901, so far as regards United States species that occur at any time south of our boundary.

In preparing the results for publication it has been deemed advisable to take up the several groups separately, and the large family of warblers has been selected as the first group to be considered. A bulletin is now nearly ready for the press in which are shown the winter and summer distribution of warblers, the routes traveled by them in passing to and fro, the times of arrival and departure at different points included in their journeys, and various other details connected with their migrations. The distribution and migration of 72 other species, which with the warblers cover the remaining species of land birds east of the Rocky Mountains that regularly migrate to points south of the United States, have also been partially determined; reports on these are expected to follow.

PUBLICATIONS.

The publications issued during the year included two numbers of North American Fauna (Nos. 20 and 21), two bulletins (15 and 16), two articles in the Yearbook for 1901, four circulars (34–37, inclusive), the report of the Division for 1901, a revised edition of Bulletin No. 12, and six reprints of former publications. The two numbers of North American Fauna were No. 20, "Revision of the skunks of the genus *Chincha*," by Arthur H. Howell, and No. 21 (a double number) the "Natural history of the Queen Charlotte Islands, British Colum-

bia" and the "Natural history of the Cook Inlet Region, Alaska," both by Wilfred H. Osgood. Bulletin No. 15, "The relation of sparrows to agriculture," by Sylvester D. Judd, embodies the results of long-continued observation and study of the native sparrows, the progress of which has been noted in previous reports. Bulletin No. 16, "Digest of game laws for 1901," by T. S. Palmer and H. W. Olds, is a compilation of laws relating to game protection similar to Bulletin No. 14 published last year, but somewhat broader in scope than that publication. The Yearbook articles are "The prairie dog of the Great Plains region," by C. Hart Merriam, and "Two vanishing game birds" (the woodcock and the wood duck), by A. K. Fisher. The circulars were as follows: No. 34, "Laws for the protection of birds and game in the District of Columbia;" No. 35, "Directory of State officials and organizations concerned with the protection of birds and game, 1902;" No. 36, "Importation of reptiles into Hawaii;" No. 37, "Regulations for the importation of eggs of game birds for propagation." Bulletin 12, a revised edition of which was published, was a treatise on "Legislation for the protection of birds," by T. S. Palmer. Three reprints were required of Farmers' Bulletin No. 54, "Some common birds in their relation to agriculture," by F. E. L. Beal, making a total of 265,000 copies issued since 1896, the date of the original publication. One reprint was necessary of each of the following publications: Bulletin 13, "Bobolinks, blackbirds, and grackles," by F. E. L. Beal; Circular 29, "Protection and importation of birds under act of Congress approved May 25, 1900," and Circular 32, "Directions for the destruction of prairie dogs" (revised edition).

ROUTINE WORK.

Routine work has increased with the growth of the Division, and demands a greater proportion of attention from the office force as time progresses. It consists of correspondence, preparation of reports and bulletins for publication, identification of specimens, care of collections, arrangement and tabulation of field reports, sorting and filing of published matter valuable for reference, attention to the needs of the field naturalists, issue of permits for the introduction of foreign mammals and birds, and cooperation in enforcing the various provisions of the act of Congress of May 25, 1900.

The letters received during the year numbered about 5,300. Many of these were accompanied by schedules or reports, and others contained notes of interest and value. During the same period 3,200 letters were written and 700 blank migration and other schedules were distributed to observers.

The large collection of photographic negatives made by members of the Biological Survey while in the field now numbers about 4,500, and is of constantly increasing value for purposes of study and illustration.

OUTLINE OF WORK FOR THE YEAR 1903.

FIELD WORK.

Field work for the current year in California will include a continuation of the biological survey of the Sierra Nevada, particularly of the western slopes and foothills, and a biological reconnoissance of the Santa Lucia Mountains and other coast ranges of the middle western part of the State. In Texas, work will be continued in

various places, connecting and completing work of previous years. Western Arizona also will be visited for the purpose of collecting material to complete former field work, and the explorations in Alaska, which were unavoidably interrupted last season, will be continued in the interior west of Cook Inlet and at the base of the Alaska Peninsula. If practicable, an extended reconnoissance along the lower Mackenzie River from Great Bear Lake to the Arctic will be undertaken in the spring for the purpose of determining the northern range and distribution of various boreal animals and plants, and to supplement the work already done in the Hudson Bay and Great Slave Lake regions. A report entitled "A biological investigation of the Hudson Bay region" has gone to press, and will appear as North American Fauna No. 22.

ECONOMIC ORNITHOLOGY.

Another visit to California to study the food habits of birds is in contemplation for the coming year. Observations covering another fruit season, and also the late winter and spring months, when birds are reported to feed upon buds and blossoms, are necessary to complete those so well begun last year. No one season accurately represents the average conditions of climate, crops, insect enemies, and other contingencies which affect the general result in such an investigation, and no matter how closely the conditions may have been studied, the results of a single season's work would be too narrow a basis upon which to ground final conclusions. In some parts of this State the bee-keeping industry is of considerable financial importance. The bee keepers, like the fruit growers, have accused certain birds of doing harm to their business; in this case, however, by eating the stock itself—the bees. It is desirable that systematic observations be made on the ground by a competent observer, and stomachs collected, as was done in the case of the birds frequenting the fruit orchards. It is designed to embody the results of these investigations, when finished, in a bulletin on the economic relations of the birds of the Pacific coast.

For several years work has been in progress on the food habits of several other groups of birds, notably the flycatchers, thrushes, swallows, and titmice. As fast as stomachs of species belonging to any of these groups have been received, they have been examined and the results tabulated. When their number is sufficient to form a basis for safe conclusions, reports on the food will be published. Work on the flycatchers and thrushes is in an advanced stage of progress, and its completion may be looked for at an early date. Investigations of the food of several other groups are also being steadily carried forward, and will form the subjects of later publications. A new and revised edition of the woodpecker bulletin is in contemplation, as, since the publication of that work the number of additional stomachs received and examined is as large as the number forming the basis of the bulletin. A report of the investigation of birds on a Maryland farm is now in press, and will soon appear as Bulletin No. 17.

GAME PROTECTION AND IMPORTATION.

Plans for the year 1903 contemplate a broader and more effective enforcement of the provisions of the Lacey Act. The methods by which the various States secure protection for their birds and game

will be investigated, and a summary of the game laws will be widely distributed, to further prevent illegal shipments of game. Methods of shipping, and, if practicable, storage of game will be more fully investigated. Cold storage is one of the most important matters connected with game protection, for if the storage of some species continues unchecked it will neutralize the efforts for their protection. Inspection at the principal ports of entry now maintained by fees should be placed on a permanent basis, but this will require a special appropriation. By strict economy the present inspection could be maintained at three of the most important ports of entry for $1,000 per annum, a very small outlay in view of the protection afforded to the entire country by such service. More effective supervision will be made of the importation of foreign birds, particularly those brought in with passengers' baggage. Of the thousands of cage birds annually imported, some do not breed in captivity; others breed in captivity, but not at large; while others, if liberated under favorable conditions, may become acclimated and increase. The first two groups may be imported with impunity, the third only under careful restrictions. To determine more fully which species belong to the third group is the object of investigation to be begun at an early date. Upland game birds and certain kinds of big game may be increased directly by propagation or by restocking depleted covers. Without duplicating the work already done by private individuals and State commissions, several lines of experiment in this connection may be advantageously taken up under Federal auspices. During the past year the Department has received the offer of a small band of elk in the San Joaquin Valley, California, believed to be a different species from the elk of the north Pacific coast. They are the sole survivors of thousands which formerly inhabited the San Joaquin Valley, and provision should be promptly made for their preservation. Their acceptance has been prevented thus far by lack of funds for securing a proper range and transporting them to it. The game law recently enacted for Alaska imposes certain duties on the Secretary of Agriculture. If it is to be carried out under the supervision of this Department, provision should be made for the employment of several wardens and also of an inspector at Seattle, Wash., during the open season to enforce the provisions against shipment of game.

MIGRATION OF BIRDS.

During the current year the bulletin on the migration of North American warblers, prepared by Prof. W. W. Cooke, will be published and Professor Cooke will continue the preparation of reports on the remaining species of land birds inhabiting the region east of the Rocky Mountains. An attempt will be made to work out the evolution of migration routes in order to account for the distribution of North and South American species of certain families. Such parts of the records of migration for 1902 as relate to the species now being studied will be compared with those of previous years in order to add the new material they may contain.

With a view to the acquisition of information that will pave the way for better protection to our shore birds, preliminary work will be begun to determine the routes of migration and winter ranges of the various species. Shore birds, as a class, are noted for the great length of their migrations and for wide dispersal over their southern ranges.

RECOMMENDATIONS.

In submitting estimates for the fiscal year 1904 the following recommendations are respectfully made: (1) An increase in the salary roll of $3,400 to provide for the employment of two additional assistants (one to be a stenographer), at $1,000 each, and the transfer of one field naturalist at $1,400, now paid from the fund for biological investigations. (2) An increase in the appropriation for biological investigations of $10,000—$3,000 to extend field work in California and Texas, $5,000 to assist in carrying out the provisions of the Lacey Act, $1,000 for the preparation and elaboration of material for publication, and $1,000 for the collation of data and mapping the distribution of mammals and birds.

REPORT OF THE CHIEF OF THE DIVISION OF ACCOUNTS AND DISBURSEMENTS.

U. S. Department of Agriculture,
Division of Accounts and Disbursements,
Washington, D. C., August 1, 1902.

Sir: I have the honor to submit herewith a report of the work of the Division of Accounts and Disbursements for the fiscal year ended June 30, 1902.

F. L. Evans, *Chief.*

Hon. James Wilson, *Secretary.*

WORK OF THE YEAR.

APPROPRIATIONS, EXPENDITURES, ETC.

Congress appropriated for the United States Department of Agriculture for the fiscal year ended June 30, 1902, the sum of $4,637,420, which included $720,000 divided equally among the 48 agricultural experiment stations in the several States, and a deficiency appropriation of $55,000.

Supplemental accounts for the years 1900 and 1901 were paid during the year amounting to $257,215.02.

The total unexpended balances of the appropriations for the year 1900, amounting to $58,418.58, were covered into the Treasury on June 30, 1902.

During the year 24,747 accounts were received, audited, and paid, as follows: Divisional, 9,588, amounting to $1,537,212.19; Bureau of Animal Industry, 4,934, amounting to $995,299.45; Weather Bureau, 10,225, amounting to $1,129,871.96—a total of $3,662,383.60, which, including the supplemental accounts, makes a grand total of $3,807,593.22. In payment of these accounts 35,620 checks were drawn on the Treasury at Washington and subtreasuries at New York and Chicago. Thirteen checks were lost, mainly in transit through the mails.

REQUISITIONS, LETTERS, REQUESTS, CONTRACTS, AND LEASES.

To meet the regular expenditures of the Department, 137 requisitions were drawn on the Treasury against the various appropriations, aggregating $3,944,339.84.

The number of requisitions for supplies was 10,178.

The number of letters of authority for travel was 2,012.

The number of letters written and received in the regular transaction of business was 42,898.

The number of requests issued for passenger transportation was 4,256.

The number of requests on the Quartermaster-General for transportation of Government property was 2,213.

The number of leases and agreements executed and in effect was 138.

The number of contracts for supplies, etc., was 220.

PUBLIC MONEYS RECEIVED FROM VARIOUS SOURCES.

There were received from all sources and deposited in the Treasury to the credit of the proper funds the following sums:

Sales of condemned property	$1,139.11
Sales of card index	145.50
Sales of publications, Weather Bureau	206.17
Seacoast telegraph line receipts, Weather Bureau	2,326.17
Sales of American products in Europe	654.16
Total	4,471.11

APPROPRIATIONS, DISBURSEMENTS, AND UNEXPENDED BALANCES.

The following table shows the appropriations, disbursements, and unexpended balances for the year ended June 30, 1902:

Appropriations, disbursements, and amount unexpended for the fiscal year 1902.

Object.	Appropriations, 1902.	Amount disbursed.	Amount unexpended.
Salaries, officers and clerks	$373,820.00	$369,318.51	$4,501.49
Library	7,000.00	5,709.84	1,290.16
Contingent expenses	37,000.00	32,963.10	4,036.90
Animal quarantine station	25,000.00	24,634.74	365.26
Collecting agricultural statistics	120,000.00	104,440.87	15,559.13
Botanical investigations and experiments	45,000.00	41,573.62	3,426.38
Entomological investigations	25,500.00	24,277.98	1,222.02
Vegetable pathological investigations	60,000.00	53,286.62	6,713.38
Biological investigations	20,000.00	18,296.95	1,703.05
Pomological investigations	20,000.00	19,464.23	535.77
Laboratory	24,500.00	23,805.60	694.40
Forestry investigations	146,280.00	111,307.42	34,972.58
Experimental gardens and grounds	20,000.00	19,305.17	694.83
Soil investigations	91,000.00	83,517.01	7,482.99
Grass and forage plant investigations	20,000.00	17,531.71	2,468.29
Irrigation investigations	50,000.00	39,225.78	10,774.22
Agricultural experiment stations ($789,000) [a]	69,000.00	66,741.71	2,258.29
Nutrition investigations	20,000.00	16,211.80	3,788.20
Arlington experimental farm	10,000.00	9,879.16	120.84
Plans for building Department of Agriculture	5,000.00	5,000.00	
Public-road inquiries	20,000.00	18,631.28	1,368.72
Publications	[b]188,000.00	169,161.55	18,838.45
Purchase and distribution of valuable seeds	270,000.00	248,610.03	21,389.97
Investigating production of domestic sugar	5,000.00	3,987.14	1,012.86
Tea-culture investigations	7,000.00	6,652.00	348.00
Bureau of Animal Industry	[c]1,090,000.00	995,299.45	94,700.55
Total	2,769,100.00	2,528,833.27	240,266.73
WEATHER BUREAU.			
Salaries	159,820.00	159,769.41	50.59
Fuel, lights, and repairs	9,000.00	8,197.16	852.84
Contingent expenses	8,000.00	6,901.66	1,098.34
General expenses, salaries $408,500 General expenses, miscellaneous 457,000	865,500.00	754,191.14	111,308.86
Meteorological observation stations	60,000.00	56,505.61	3,494.39
Buildings	46,000.00	32,351.58	13,648.42
Total, Weather Bureau	1,148,320.00	1,017,866.56	130,453.44
Grand total	3,917,420.00	3,546,699.83	370,720.17

[a] Of this amount, $720,000 was paid directly to the experiment stations from the Treasury Department.

[b] Including a deficiency appropriation of $15,000.

[c] Including a deficiency appropriation of $40,000.

ACCOUNTS FOR THE FISCAL YEAR 1900 FINALLY CLOSED.

The accounts for the year ended June 30, 1900, were finally closed on June 30, 1902, and the balances under the various appropriations were turned into the Treasury on that date and carried to the surplus fund, as follows:

Amount of unexpended balances turned into the Treasury.

Object.	Appropriations, 1900.	Amount disbursed.	Amount unexpended.
Salaries, officers and clerks	$336,340.00	$330,666.24	$5,673.76
Furniture, cases, and repairs	10,000.00	9,771.27	228.73
Library	5,000.00	4,291.17	708.83
Museum	1,500.00	1,490.01	9.99
Postage	2,000.00	2,000.00	
Contingent expenses	25,000.00	23,769.38	1,230.62
Animal quarantine stations	12,000.00	11,477.87	522.13
Collecting agricultural statistics	110,000.00	107,653.62	2,346.38
Botanical investigations and experiments	20,000.00	19,689.51	310.49
Entomological investigations	20,000.00	19,920.64	79.36
Vegetable pathological investigations	26,000.00	25,854.44	145.56
Biological investigations	17,500.00	17,344.00	156.00
Pomological investigations	9,500.00	9,099.61	400.39
Laboratory	17,700.00	17,182.80	517.20
Forestry investigations	40,000.00	39,991.49	8.51
Experimental gardens and grounds	28,000.00	27,589.66	410.34
Soil investigations	20,000.00	19,717.02	282.98
Grass and forage plant investigations	12,000.00	11,566.84	433.16
Irrigation investigations	35,000.00	33,732.57	1,267.43
Agricultural experiment stations ($765,000)[a]	45,000.00	43,702.20	1,297.80
Nutrition investigations	15,000.00	14,950.86	49.14
Public-road inquiries	8,000.00	7,854.35	145.65
Publications	80,000.00	79,516.76	483.24
Purchase and distribution of valuable seeds	130,000.00	128,366.13	1,633.87
Investigating production of domestic sugar	7,000.00	6,717.82	282.18
Tea-culture investigations	1,000.00	999.33	.67
Salaries and expenses, Bureau of Animal Industry	950,000.00	918,449.03	31,550.97
Total	1,983,540.00	1,933,364.62	50,175.38
WEATHER BUREAU.			
Salaries	153,320.00	152,835.99	484.01
Fuel, lights, and repairs	8,000.00	7,635.34	364.66
Contingent expenses	8,000.00	7,635.70	364.30
General expenses, salaries $382,195	768,162.00	381,980.16	214.84
General expenses, miscellaneous 385,967		381,446.11	4,520.89
Meteorological observation stations	60,000.00	57,754.71	2,245.29
Building	25,000.00	24,950.79	49.21
Total, Weather Bureau	1,022,482.00	1,014,238.80	8,243.20
Grand total	3,006,022.00		

[a] Of this amount, $720,000 was paid directly to the experiment stations from the Treasury Department.

MONTHLY CHECK STATEMENTS, SETTLEMENT OF ACCOUNTS, ETC.

The monthly check statements from the Treasury and subtreasuries were received and found to agree with the books of this office. All vouchers were forwarded quarterly to the Treasury, passed upon by the accounting officers, and certified as correct. The annual report to Congress of all expenditures of the Department for the year 1901 was prepared in this office and submitted through the Speaker of the House of Representatives.

The amount expended for telegraphing and telephoning by the Weather Bureau, including the West Indian cable service, was $195,473.27.

WEATHER BUREAU BUILDINGS.

Buildings were erected during the past fiscal year by the Weather Bureau, under specific provision of law, at the following-described places, and at the cost set opposite to each:

Atlantic City, N. J	$6,000.00
Hatteras, N. C	5,000.00
Tatoosh Island, Washington	4,950.00
Point Reyes, Cal	2,989.90
North Head, Wash	3,929.63
Port Crescent, Wash	1,000.00

Buildings at the following stations were repaired and remodeled:

Bismarck, N. Dak	$7,064.14
Cape Henry, Virginia	5,112.45
Jupiter, Fla	3,393.25
Kittyhawk, N. C	125.00

ANNUAL SUPPLIES.

Bids for annual supplies were solicited in May of last year in the usual manner. All bids received in response to advertisement were passed upon by the board of awards, and contracts were made covering nearly all the lines of supplies needed by the Department during the ensuing fiscal year at the best prices that could be obtained.

CONTRACT FOR SEEDS.

A contract for seeds for Congressional distribution was made for 1902 with the Henry Philipps Seed and Implement Company, of Toledo, Ohio, for $180,011.80. The balance of the appropriation of $270,000 was expended in the purchase of seeds in the open market.

ESTIMATES OF APPROPRIATIONS.

The estimates of appropriations for the year ending June 30, 1903, were prepared in this office according to the usual practice, and were submitted to Congress through the Secretary of the Treasury, accompanied by an explanation of all changes from the appropriations of the preceding year. The estimates amounted to $4,789,540, or $872,120 more than the appropriations for 1902, and $285,580 more than the amount finally appropriated for 1903.

IMMEDIATELY AVAILABLE APPROPRIATIONS.

The only appropriations for 1903 containing immediately available provisions are as follows:

Vegetable pathological investigations	$5,000
Entomological investigations	8,000
Biological investigations	2,000

APPROPRIATIONS AND ESTIMATES FOR 1903.

The appropriations and estimates for the Department for 1903 are shown in the table on the next page.

Appropriations and estimates for 1903.

Object.	Amount appropriated for 1903.	Amount estimated for 1903.
Salaries, officers and clerks	$465,500	$487,770
Library	8,000	11,000
Contingent expenses	37,000	37,000
Vegetable pathological investigations	110,000	118,000
Pomological investigations	30,000	30,000
Botanical investigations and experiments	55,000	65,000
Grass and forage plant investigations	30,000	45,000
Experimental gardens and grounds	25,000	35,000
Arlington experimental farm	15,000	25,000
Investigating production of domestic sugar	5,000	5,000
Tea-culture investigations	10,000	10,000
Purchase and distribution of valuable seeds	270,000	270,000
Forestry investigations	254,000	260,180
Laboratory	60,500	49,500
Soil investigations	130,000	173,000
Entomological investigations	45,500	30,500
Biological investigations	28,000	30,000
Publications	200,000	215,000
Collecting agricultural statistics	94,200	108,000
Agricultural experiment stations ($796,000) [a]	76,000	105,000
Nutrition investigations	20,000	30,000
Irrigation investigations	65,000	75,000
Public-road inquiries	30,000	40,000
Foreign market investigations	6,500	6,500
Silk investigations	10,000	10,000
Expenses, Bureau of Animal Industry	1,160,000	1,300,000
Total	3,240,200	3,571,450
WEATHER BUREAU.		
Salaries	165,260	172,590
Fuel, lights, and repairs	10,000	12,000
Contingent expenses	8,000	8,000
General expenses	915,500	915,500
Meteorological observation stations	60,000	60,000
Buildings	50,000	50,000
Cables and land lines	40,000	----------
Storm-warning stations, Glenhaven and South Manitou Island, Mich.	15,000	----------
Total, Weather Bureau	1,263,760	1,218,090
Grand total	4,503,960	4,789,540

[a] Of this amount $720,000 is paid directly to the experiment stations from the Treasury Department.

APPROPRIATIONS FOR 1902 AND 1903.

The appropriations for 1902 and 1903 are shown in the following table, and it will be seen that there is an increase in favor of the latter year of $641,540:

Appropriations for the years 1902 and 1903.

Object.	Amount appropriated for 1902.	Amount appropriated for 1903.
Salaries, officers and clerks	$373,820	$465,500
Library	7,000	8,000
Contingent expenses	37,000	37,000
Vegetable pathological investigations	60,000	105,000
Pomological investigations	20,000	30,000
Botanical investigations and experiments	45,000	55,000
Grass and forage plant investigations	20,000	30,000
Experimental gardens and grounds	20,000	25,000
Arlington experimental farm	10,000	15,000
Investigating production of domestic sugar	5,000	5,000
Tea-culture investigations	7,000	10,000
Purchase and distribution of valuable seeds	270,000	270,000
Forestry investigations	146,280	254,000
Laboratory	24,500	60,500
Soil investigations	91,000	130,000

Appropriations for the years 1902 and 1903—Continued.

Object.	Amount appropriated for 1902.	Amount appropriated for 1903.
Plans for building, Department of Agriculture	$5,000	
Entomological investigations	25,500	$45,500
Biological investigations	20,000	28,000
Publications	173,000	200,000
Collecting agricultural statistics	105,000	94,200
Agricultural experiment stations ($796,000) [a]	69,000	76,000
Nutrition investigations	20,000	20,000
Irrigation investigations	50,000	65,000
Public-road inquiries	20,000	30,000
Foreign market investigations	15,000	6,500
Silk investigations		10,000
Quarantine stations	25,000	
Expenses, Bureau of Animal Industry	1,050,000	1,160,000
Total	2,714,100	3,240,200
WEATHER BUREAU.		
Salaries	159,820	165,260
Fuel, lights, and repairs	9,000	10,000
Contingent expenses	8,000	8,000
General expenses	865,500	915,500
Meteorological observation stations	60,000	60,000
Buildings	46,000	50,000
Cables and land lines		40,000
Storm-warning stations, Glenhaven and South Manitou Island, Mich.		15,000
Total, Weather Bureau	1,148,320	1,263,760
Grand total	3,862,420	4,503,960

[a] The total appropriations under this head are $789,000 and $796,000 for the years given, respectively, but $720,000 of each appropriation is paid directly to the experiment stations from the Treasury Department. The sums included in the figure columns represent only the amount available for departmental expenditures.

INCREASE IN THE APPROPRIATIONS IN SIX YEARS.

During the present administration of the Department, fiscal years 1898–1903, the appropriations, exclusive of the agricultural experiment stations, have expanded from $2,467,902 to $4,503,960, an increase of $2,036,058.

INCREASE IN STATUTORY SALARY ROLLS.

The statutory rolls of the Department increased from $533,640 in 1902 to $630,760 in 1903. This increase is not an actual increase either of salary or clerical force, but is due to the transfer to the statutory rolls of clerks who have heretofore been paid from the lump sum rolls, and were then, as now, a part of the permanent force of the Department. These transfers were made on the recommendation of the agricultural committees of both the Senate and the House of Representatives.

INCREASE IN SALARIES.

An increase in the salaries of the following chiefs and officers of Bureaus and Divisions was made by Congress, to take effect on July 1, 1902:

Bureau of Animal Industry	from	$4,000 to $4,500
Bureau of Plant Industry	do	3,000 to 4,000
Bureau of Soils	do	3,000 to 3,500
Bureau of Forestry	do	3,000 to 3,500
Bureau of Chemistry	do	3,000 to 3,500
Division of Entomology	do	2,500 to 2,750
Division of Biological Survey	do	2,500 to 2,750
Division of Vegetable Pathology and Physiology	do	2,500 to 2,750
Division of Zoology	do	2,250 to 2,500

NEW BUILDINGS FOR WEATHER BUREAU STATIONS.

The sum of $50,000 is appropriated for 1903, for the purchase of sites and the erection of not less than six buildings for use as Weather Bureau observatories; $40,000 is appropriated for same year for the purchase and construction of cables and land lines to connect the Farallone Islands, California, with the mainland, and Womans Key, or Sand Key, Florida, with Key West, Fla., and "the sum of fifteen thousand dollars * * * is appropriated for the purpose of constructing, maintaining, repairing, and operating, under the direction of the Secretary of Agriculture, telegraph, cable, or telephone lines between Glenhaven, Michigan, and South Manitou Island, Lake Michigan, and for the establishment, equipment, and maintenance of storm-warning stations at those points."

ADDITIONAL LAND AT BETHESDA, MD.

The appropriation for the Bureau of Animal Industry for 1903 provides "that not to exceed ten thousand dollars of the amount hereby appropriated may be used to purchase additional land for the Bureau experiment station at Bethesda, Maryland." Negotiations are now in progress for the purchase of 30 acres of land adjoining the present station, which, if secured, will provide a total area for the station of 50 acres.

SEED WAREHOUSE.

Of the amount appropriated for the purchase and distribution of valuable seeds, 1903, $10,000 may be used for "the erection of a suitable seed warehouse on the Department grounds for receiving, storing, cleaning, and properly preparing the seed handled by the Department." Plans and specifications have been prepared and bids invited for the erection of a building in accordance with this provision of the act, but no contract has yet been awarded.

BUILDINGS UNDER LEASE IN THE DISTRICT OF COLUMBIA, WITH ANNUAL RENTAL.

The amount appropriated for rental for the several branches of the Department in the District of Columbia for 1903 is $21,700, against $12,600 for 1902, being an increase of $10,200 per year, as follows:

Bureaus and Divisions.	1902.	1903.
Bureau of Chemistry, laboratory and offices, 200 Fourteenth street SW	$2,500	$2,500
Bureau of Animal Industry, laboratory and offices, 1362 B street SW	1,800	1,800
Bureau of Soils, laboratory and offices, 212 and 214 Thirteenth street SW	1,400	2,000
Bureau of Forestry, offices, Atlantic Building	2,000	6,000
Bureau of Plant Industry:		
Vegetable Pathology and Physiology, laboratories and offices, 1306 B street SW	1,400	3,000
Botany, laboratory and offices	1,000	3,000
Division of Publications, document rooms, 1304 B street SW	2,500	1,400
Division of Seeds, warerooms, Thirteen-and-a-half street SW	.....	2,000
Total	12,600	21,700

PLANS FOR ADMINISTRATIVE BUILDING.

Five thousand dollars was appropriated in 1902 to enable the Secretary of Agriculture to have prepared plans and specifications for an

administrative building. The entire sum was expended in compliance with the provision of the act, and carefully prepared plans on the basis of a $2,500,000 building were submitted by the Secretary of Agriculture at the last session of Congress. House bill No. 7207 for $2,000,000 was prepared and introduced, but no appropriation was made for a building.

SILK INVESTIGATIONS.

The appropriation act for 1903 carries an item of $10,000 for the collection and dissemination of information relating to silk culture in the United States. During the period from 1884 to 1891, inclusive, the sum of $128,341.69 was appropriated for investigation of the silk industry.

CONTINGENT EXPENSES.

No increase has been made in the appropriation for contingent expenses since 1892, while during this period the total appropriations of the Department have more than doubled, proportionately increasing the demands upon the contingent fund. In order to meet, in some measure, this demand, certain changes were made in the language of the lump sum appropriations of the several Bureaus and large Divisions for the year beginning July 1, 1902, to provide for payment from these funds for furniture and general supplies that have heretofore been paid for from the contingent fund. Hereafter supplies of this character intended for the use of these various branches will be charged to their respective funds. This will relieve the contingent appropriation sufficiently to enable the fund to take care of all strictly contingent expenses.

LAW CLERK.

The estimates for 1903 provided for one law clerk at a salary of $2,000, but no appropriation was made by Congress for a law clerk in compliance with the estimates. The urgent need for such an officer in the Department of Agriculture is too apparent to require argument. The services of a law clerk are as necessary in conducting the business affairs of the Department as are those of a disbursing clerk, and it is a generally admitted fact that the latter officer is an essential factor in the general economy of the Department. The legal work of the Department, which is now being conducted by a third-class clerk detailed from the Secretary's roll, must be done here in the Department, and can not be referred or attended to by the Department of Justice. It would be wholly impracticable for that Department to take up the details of the legal work of this Department. This question has been fully discussed with the officials of the Department of Justice. The legal work of the Department of Agriculture, which includes the careful and technical preparation of hundreds of legal papers, has increased enormously in the last few years, and will continue to grow with the natural expansion of the Department, while the importance of the questions presented, almost daily, are of the utmost gravity to the interests of the Government, and must be dealt with, when presented, by a mind carefully and legally trained. An appropriation for a law clerk at a fair salary can not be too strongly or urgently recommended.

APPROPRIATION ACT FOR 1903.

The appropriation act for the year 1903 contains the following provision:

Provided further, That hereafter the estimates of appropriations for the Department of Agriculture shall be prepared and submitted each year according to the order and arrangement of the act for the year preceding; and any changes in such order or arrangement desired by the Secretary of Agriculture may be submitted by note in the estimates.

It shall be the duty of the Secretary of Agriculture to submit in the Book of Estimates for the fiscal year nineteen hundred and four, and annually thereafter, immediately following estimates of each of the respective Offices, Bureaus, and Divisions of the Department of Agriculture a statement showing in detail the number of clerks who were employed in the District of Columbia upon regular and continuous work for thirty days or more during the previous fiscal year in or under such Offices, Bureaus, or Divisions under authority of and paid from general appropriations, indicating in the case of every such employment the rate of compensation received and the appropriation from which paid.

CONDITION OF THE WORK IN THE DIVISION.

While there was a very noticeable increase in the volume of work in the Division during the last fiscal year, resulting from the largely increased appropriations, the work was handled with the usual dispatch and accuracy by the regular clerical force of the Division, and no part of it was allowed to fall in arrears.

LEASED BUILDINGS OUTSIDE DISTRICT OF COLUMBIA, WITH LOCATION AND MONTHLY AND ANNUAL RENTAL.

The following are the Bureau of Animal Industry, botanical, irrigation, and Weather Bureau stations under lease by the Department outside of the District of Columbia during the year ended June 30, 1902:

Stations, with location and monthly or annual rental.

BUREAU OF ANIMAL INDUSTRY.

Station.	Location.	Rent.
Baltimore, Md	No. 215 St. Paul street	$125 per annum.
Boston, Mass	No. 44 Kilby street	$30 per month.
Buffalo, N. Y	East Buffalo Live Stock Exchange Building	Do.
Chicago, Ill	No. 4193 South Halsted street	$225 per month.
Do	Union Stock Yards, Exchange Building	$125 per month.
Indianapolis, Ind	11 Live Stock Exchange Building	$10 per month.
Kansas City, Kans	Corner Central and James streets	$45 per month.
Littleton, Mass	Quarantine station	$250 per annum.
Louisville, Ky	No. 507 Johnson street	$10 per month.
National Stock Yards, Illinois.	Live Stock Exchange Building	$50 per month.
New York, N. Y	No. 18 Broadway	$500 per annum.
Do	No. 109 West Forty-second street	$40 per month.
Norfolk, Va	No. 70 Plume street	$210 per annum.
Sioux City, Iowa	Exchange Building, stock yards	$20 per month.
South St. Joseph, Mo	Live Stock Exchange Building	$45 per month.
Halethorp, Md	Quarantine stations	$225 per annum.
Cincinnati, Ohio	Exchange Building, Johnson street	$180 per annum.
Milwaukee, Wis	Gross Building	$17 per month.
Knoxville, Tenn	The Deaderick Building	$10 per month.

BOTANICAL INVESTIGATIONS.

Kensington, Md		$50 per annum.

IRRIGATION INVESTIGATIONS.

Cheyenne, Wyo	Warner Block, Sixteenth street	$20 per month.

Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.

	Station.	Location.	Rent.	
			Amount.	Includes—
	STATIONS IN THE UNITED STATES.			
1	Abilene, Tex	On South First street	a $381.80	Heat, cleaner, light, and water.
2	Albany, N. Y	In public building, corner Broadway and State street		
3	Alpena, Mich	Corner Fletcher and Dock streets	a 211.36	Heat, cleaner, light, oil, matches, ink, and mucilage.
4	Amarillo, Tex	On corner Polk and Fifth streets	a 120.00	Closet for storage.
		On Taylor street between Seventh and Eighth streets	b 216.00	
5	Astoria, Oreg	No. 545 Commercial street	a 252.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, and ice.
6	Atlanta, Ga	In Empire Building, corner Broad and Marietta streets	a 900.00	Heat, cleaner, light, and icewater.
7	Atlantic City, N. J	In Weather Bureau Building, corner Rhode Island and Pacific avenues.		
8	Augusta, Ga	In public building, corner Campbell and Greene streets		
9	Baker City, Oreg	In Pollman Building, Main street	a 450.00	Heat, cleaner, light, and water.
10	Baltimore, Md	Johns Hopkins University, 532 North Howard street		
11	Binghamton, N. Y	In public building, corner Wall and Henry streets		
12	Birmingham, Ala	In Walker & Jordan Building, 2011 First avenue	b 120.00	Electric light and telephone.
13	Bismarck, N. Dak	In public building, corner Main and First streets		
14	Block Island, R. I	On Main street	a 259.97	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and use of cellar.
		On cupola of National Hotel, on Main street	b 20.00	For exposure of wind instruments.
15	Boise, Idaho	In Sonna Building, No. 228 Main street	a 480.00	Heat, janitor service, light, hot and cold water.
16	Boston, Mass	In public building, Post-Office square		
17	Buffalo, N. Y	In Prudential Building, corner Pearl and Church streets	a 680.00	Heat, cleaner, light, and electric current for motor of printing press.
18	Buxton, N. C	Near Buxton, Dare County, N. C	b 40.00	Rent of ground.
19	Cairo, Ill	In public building, corner Washington avenue and Fourteenth street.		
20	Cape Henry, Va	In Weather Bureau Building, on the beach		
21	Cape May, N. J	No. 510 Hughes street	a 420.00	Heat, cleaner, and light.
22	Carson City, Nev	In public building, on Carson street		
23	Charleston, S. C	In public building, 200 East Bay street		
24	Charlotte, N. C	In public building, corner Trade and Mint streets		
25	Chattanooga, Tenn	In public building, corner Eleventh and A streets		
26	Cheyenne, Wyo	In Commercial Building, 216-218 West Sixteenth street	a 517.61	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, water, and soap.
27	Chicago, Ill	Auditorium Building, corner Wabash avenue and Congress street.	a 1,750.00	Heat, cleaner, light, water, and elevator service.
28	Cincinnati, Ohio	In public building, Fifth street between Walnut and Main streets		

29	Cleveland, Ohio	In Society for Savings Building, corner Public Square and Ontario street.	a1,140.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, toilet supplies, power for electric motor, gas for stereotyping, electricity for signals, and storeroom.
30	Columbia, Mo	In Agricultural College Building, campus State University		
31	Columbia, S. C	In City Hall, northwest corner Main and Gervais streets	a360.00	Heat, cleaner, and light.
32	Columbus, Ohio	In Hayden Building, 16 and 18 East Broad street	a1,200.00	Heat, cleaner, light, gas for stereotyping, electric power for printing press, and ice water.
33	Concordia, Kans	Post-office building, 204 Sixth street	a292.00	Heat, cleaner, light, matches, and ice.
34	Corpus Christi, Tex	In Hatch & Robertson Building, corner Mesquite and Peoples streets.	a259.00	Heat, cleaner, and light.
35	Currituck Inlet, N. C	In United States Life-Saving Station Building		
36	Davenport, Iowa	In public building, corner Fourth and Perry streets		
37	Denver, Colo	In public building, corner Sixteenth and Arapahoe streets		
38	Des Moines, Iowa	In public building, corner Fifth street and Court avenue		
39	Detroit, Mich	Union Trust Building, corner Griswold and Congress streets	a670.00	Heat, cleaner, electric light and power, oil, matches, ink, mucilage, brooms, ice, water, soap, and elevator.
40	Dodge, Kans	Beeson Block, on Front street	a355.65	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, water, soap, brushes, stove polish, and lavatory.
41	Dubuque, Iowa	In public building, corner Court avenue and Fifth street		
42	Duluth, Minn	In public building, First street and Fifth avenue west		
43	East Clallam, Wash	In telegraph office, Frontier street	60.00	
44	Eastport, Me	In public building, corner Water and Washington streets		
45	Elkins, W. Va	In Warfield & Dann Building, corner Third street and Davis avenue.	a288.00	Heat, cleaner, light, and water.
46	El Paso, Tex	In public building, St. Louis and Oregon streets		
47	Erie, Pa	In public building, Park Row and State street		
48	Escanaba, Mich	In Semer Block, corner Ludington street and Harrison avenue	a450.00	Heat, cleaner, light, and water.
49	Eureka, Cal	In Buhne's brick building, corner Second and G streets	a368.80	Heat, cleaner, light, and water.
50	Evansville, Ind	In Federal Building, Second street between Vine and Sycamore streets.		
51	Flagstaff, Ariz	In Milligan Cottage, corner Aspen avenue and Park street	a600.00	Heat, cleaner, light, and ice.
52	Fort Smith, Ark	In public building, on Sixth street		
53	Fort Worth, Tex	In public building, corner Jennings avenue and Texas street		
54	Fresno, Cal	Farmers' National Bank of Fresno Building, No. 1056 I street	a378.00	Heat, cleaner, and light.
55	Galveston, Tex	In Improvement, Loan and Trust Building, 2222 Post-Office street.	a600.00	Heat, cleaner, light, water, elevator, brooms, ice, and soap.
56	Grand Haven, Mich	Cutler House, corner Third and Washington streets	a230.00	Heat, cleaner, and light.
57	Grand Junction, Colo	In Canon Block, corner Fourth and Main streets	a480.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, soap, and towels.
58	Green Bay, Wis	In Parmentier Block, 324–328 Washington street	a297.00	Heat, cleaner, light, and water.
59	Hannibal, Mo	In public building, corner Broadway and Sixth street		
60	Harrisburg, Pa	In public building, corner third and Walnut streets		
61	Hatteras, N. C	In Weather Bureau Building		
62	Havre, Mont	In Gussenhoven Building, First street between Third and Fourth avenues.	a360.00	Heat, cleaner, light, matches, brooms, ice, and water.
63	Helena, Mont	In Power Block, corner Main street and Sixth avenue	a588.00	Heat, cleaner, and light.
64	Houghton, Mich	In Shelden Building, northwest corner Shelden and Isle Royale streets.	a375.00	Heat, hot and cold water.
65	Huron, S. Dak	In Jeffris Block, 337 Dakota avenue	a500.00	Heat, cleaner, light, water, and water-closet.
66	Independence, Cal	In Norman House, corner Market and Edward streets	a360.00	Heat, cleaner, light, and water.

a In accordance with existing lease.

b Under written agreement, lease being impracticable.

Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.—Continued.

	Station.	Location.	Rent.	
			Amount.	Includes—
	STATIONS IN THE UNITED STATES—continued.			
67	Indianapolis, Ind	In Majestic Building, corner Pennsylvania and Maryland streets	a $1,025.00	Heat, cleaner, and light.
68	Ithaca, N. Y	In Lincoln Hall, Cornell University		
69	Jacksonville, Fla	In Dyal-Upchurch Building, southeast corner Main and Bay streets.	a 750.00	Heat, cleaner, and light.
70	Jupiter, Fla	In Weather Bureau Building near light-house		
71	Kalispell, Mont	In Conrad National Bank Building, corner Main and Second streets.	a 270.00	Heat, light, and janitor service.
72	Kansas City, Mo	In Rialto Building, corner Grand avenue and Ninth street	a 660.00	Heat, cleaner, light, brooms, ice water, and water.
73	Keokuk, Iowa	In public building, corner Seventh and Blondeau streets		
74	Key West, Fla	In Waite Building, corner Duval and Wall streets	a 437.80	Heat, cleaner, light, and water.
75	Kittyhawk, N. C	In Weather Bureau Building, on the beach		
76	Knoxville, Tenn	University of Tennessee		
77	La Crosse, Wis	In public building, corner Fourth and State streets		
78	Lander, Wyo	In Fremont Lumber Company Building, 36 Main street	a 351.00	Heat, cleaner, and light.
79	Lansing, Mich	In Federal Building, corner Michigan and Capitol avenues		
80	Lewiston, Idaho	In Dent & Butler Building, 319 E street	a 420.00	Heat, light, water, use of toilet, washstand, use of roof, and janitor service.
81	Lexington, Ky	In State College Building, south Limestone street		
82	Lincoln, Nebr	In University of Nebraska Building, corner Twelfth and T streets.		
83	Little Rock, Ark	In public building, on Second street, between Center and Spring		
84	Los Angeles, Cal	In Wilson Building, 102½ south Spring street	a 563.30	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and water.
85	Louisville, Ky	In public building, corner Fourth and Chestnut streets		
86	Lynchburg, Va	In Law Building, 807 Main street	a 270.00	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, water, and soap.
87	Macon, Ga	In public building, corner Third and Mulberry streets		
88	Manteo, N. C	At Weirs Point, near Manteo, N. C	b 40.00	Rent of ground.
		In Hotel Roanoke	b 96.00	Heat, cleaner, light, oil, matches, brooms, ice, soap, and water.
89	Marquette, Mich	In Marquette County Savings Bank, southeast corner Washington and Front streets.	a 360.00	Heat and water.
90	Memphis, Tenn	In Porter Building, corner Main and south Court streets	a 600.00	Heat, cleaner, light, water, and elevator.
91	Meridian, Miss	In public building, corner Twenty-second avenue and Eighth street.		
92	Miles City, Mont	In Leighton Building, on Main street	a 168.00	Heat, light, oil, matches, ink, mucilage, brooms, and ice.
93	Milwaukee, Wis	In public building, Wisconsin street, between Jefferson and Jackson streets.		
94	Minneapolis, Minn	In public building, corner Third street and First avenue, south		
95	Mobile, Ala	In public building, corner St. Francis and Royal streets		

96	Modena, Utah	In Utah and Pacific Railroad depot	[a]180.00	Heat, cleaner, light, matches, brooms, and exposure for instruments.
97	Montgomery, Ala	In public building, corner Lawrence street and Dexter avenue		
98	Moorhead, Minn	In First National Bank, corner Front and Sixth streets	[a]265.25	Heat, cleaner, light for office, matches, ink, mucilage, brooms, ice, water, and soap.
99	Mount Tamalpais, Cal	In Observatory Building, eastern peak Mount Tamalpais	[a]420.00	Heat, light, water, and transportation for employees and supplies.
100	Mount Washington, N. H.	On summit	[a]5.00	For rent of ground on which Weather Bureau Building is located.
101	Nantucket, Mass	In Pacific Club House, corner Main and Water streets	[a]263.00	Heat, light, and water.
102	Narragansett Pier, R. I.	In Odlen Cottage, Kingstown street	[a]150.96	Heat, light, matches, ink, mucilage, and brooms.
103	Nashville, Tenn	In Chamber of Commerce, 309 Church street	[b]500.00	Heat, cleaner, and light.
104	Neah Bay, Wash	In Indian Agency building, facing bay		
105	New Brunswick, N. J	In New Jersey Experiment Station Building, corner Bleecker Place and Hamilton street.		
106	New Haven, Conn	In Insurance Building, 890 Chapel street	[a]384.00	Heat, cleaner, and light.
107	New Orleans, La	In public building, corner Decatur and Customhouse streets		
108	New York, N. Y	In American Surety Building, 100 Broadway	[a]2,500.00	Heat, cleaner, light for office and signals, electricity or gas for stereotyping, electric current for printing press, use of flagstaff, elevators, roof, and storage for property.
109	Norfolk, Va	In Citizens Bank Building, 191–195 Main street	[a]525.00	Heat, cleaner, electric light for office and storm signals, and ice water.
110	Northfield, Vt	In Norwich University, on Central street		
111	North Head, Wash	In Weather Bureau Building		
112	North Platte, Nebr	In Odd Fellows' Hall, corner Fifth and Dewey streets	[a]339.50	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
113	Oklahoma, Okla	In Culbertson Building, corner Broadway and Grand avenue	[a]510.00	Heat, cleaner, light, and water.
114	Omaha, Nebr	In public building, corner Sixteenth and Dodge streets		
115	Oswego, N. Y	In public building, Oneida street		
116	Palestine, Tex	In City Hall, corner of Palmer and Oak streets	[a]314.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, and soap.
117	Parkersburg, W. Va	In public building, corner Fifth and Juliana streets		
118	Pensacola, Fla	In public building, corner Palafox and Government streets		
119	Phoenix, Ariz	In Talbot Building, corner north First avenue and Adams street	[a]480.00	Water-closet and lavatory.
120	Philadelphia, Pa	In public building, corner Ninth and Chestnut streets		
121	Pierre, S. Dak	In Geiger's Block, Pierre street, near Dakota avenue	[a]240.00	Heat, light, matches, ink, mucilage, brooms, ice, water, and soap.
122	Pittsburg, Pa	In public building, Smithfield street, Third to Fourth avenue		
123	Pocatello, Idaho	In Cook Building, 343 west Center street	360.00	Heat, cleaner, light, and water.
124	Point Reyes, Cal	In Weather Bureau Building		
125	Port Crescent, Wash	In Hart Building, corner Third and A streets	[a]96.00	
126	Port Huron, Mich	In Federal Building, corner Sixth and Water streets		
127	Portland, Me	First National Bank, 57 Exchange street	[a]504.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and soap.
128	Portland, Oreg	In public building, corner Davis and north Seventh streets		
129	Pueblo, Colo	In public building, corner Sixth and Main streets		
130	Raleigh, N. C	In Fisher Building, corner Fayetteville street and Exchange Place.	[a]240.00	Water rent for water-closet.
131	Rapid City, S. Dak	In Lakota Building, corner Seventh and St. Joe streets	[a]378.00	Heat, cleaner, light, and water.

[a] In accordance with existing lease.

[b] Under written agreement, lease being impracticable.

Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.—Continued.

	Station.	Location.	Rent.	
			Amount.	Includes—
	STATIONS IN THE UNITED STATES—continued.			
132	Red Bluff, Cal	In Bank of Tehama County, Cal., corner of Main and Walnut streets.	a$396.25	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and soap.
133	Richmond, Va	In Times Building, corner Bank and Tenth streets	a600.00	Heat, cleaner, light, water, elevator, electric power for press, and gas for stereotyping furnace.
134	Rochester, N. Y	In public building, corner Church and Fitzhugh streets		
135	Roseburg, Oreg	In Marks Building, 228½ Jackson street	a339.00	Heat, cleaner, light, and water.
136	Sacramento, Cal	In public building, corner Seventh and K streets		
137	St. Louis, Mo	In public building, on Olive street, between Eighth and Ninth		
138	St. Paul, Minn	In Chamber of Commerce Building, 112 east Sixth street	a372.85	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, soap, and chimneys.
139	Salt Lake City, Utah	In Dooly Block, corner west Temple and Second South streets	a600.00	Heat, cleaner, light, matches, brooms, water, and elevator.
140	San Antonio, Tex	In Hicks Building, corner Avenue C and East Houston street	a480.00	Heat, cleaner, and water.
141	San Diego, Cal	In Keating Building, corner Fifth and F streets	a360.00	Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
142	Sandusky, Ohio	In public building, corner Columbus avenue and Market street		
143	San Francisco, Cal	In Mills Building, corner Bush and Montgomery streets	a1,290.00	Heat, cleaner, light, water, electric power for printing press, and gas for stereotyping.
144	San Luis Obispo, Cal	In Crocker Building, corner Garden and Higuera streets	a300.00	Heat, cleaner, light, and water.
145	Santa Fe, N. Mex	In Catron Building, corner Plaza on Palace avenue	a420.00	Heat, light, and water.
146	Sault Ste. Marie, Mich	In Weather Bureau Building on Government reservation, known as "Canal grounds."		
147	Savannah, Ga	In public building, corner President and Whitaker streets		
148	Scranton, Pa	In Connell Building, 127 Washington avenue	a475.00	Heat, cleaner, and light.
149	Seattle, Wash	In New York Building, 704 Second avenue	a480.00	Heat, cleaner, light, and water.
150	Shreveport, La	In public building, corner Texas and Marshall streets		
151	Sioux City, Iowa	In public building, corner Sixth and Douglas streets		
152	Spokane, Wash	In Empire State Building, corner Lincoln and Riverside avenues	a660.00	Heat, cleaner, and light.
153	Springfield, Ill	In public building, corner Monroe and Sixth streets		
154	Springfield, Mo	In public building, corner Boonville and Brower streets		
155	Tacoma, Wash	In Chamber of Commerce Building, corner C and Ninth streets	a300.00	Heat, cleaner, and light.
156	Tampa, Fla	In Knight Building, 315½ Franklin street	a328.75	Heat, cleaner, light, matches, ink, mucilage, and ice.
157	Tatoosh Island, Wash	In Weather Bureau Building		
158	Taylor, Tex	In Taylor National Bank Building, 200 Main street	575.00	Heat, cleaner, light, and water.
159	Toledo, Ohio	In public building, corner Madison and St. Clair streets		
160	Topeka, Kans	In Columbia Building, 112 west Sixth avenue	a350.00	Heat, cleaner, light, ink, mucilage, brooms, ice, and water.
161	Twin, Wash	In Jones Building	a100.00	
162	Valentine, Nebr	In Fraternal Hall Building, on Main street	a420.00	Heat, cleaner, light, water, and water-closet.
163	Vicksburg, Miss	In public building, corner Crawford and Walnut streets		
164	Walla Walla, Wash	In Paine Brothers' Building, corner Main and Second streets	a295.80	Heat, cleaner, brooms, and soap.

165	Wichita, Kans	In The Sedgwick, corner First and Market streets	[a] 280.00	Heat, cleaner, and light.
166	Williston, N. Dak	Corner Main and Third streets	[a] 350.00	Heat, cleaner, and light.
167	Wilmington, N. C	In public building, corner Front and Chestnut streets		
168	Winnemucca, Nev	In county court-house, on Bridge street	[a] 268.00	Heat, cleaner, light, matches, ink, mucilage, brooms, and water.
169	Yankton, S. Dak	In Wagner Block, 307 and 309 Walnut street	[a] 300.00	Heat, light, and janitor service.
170	Yuma, Ariz	In public building, on Government reservation		
	Total		42,036.65	
	WEST INDIAN STATIONS.			
171	Basseterre, St. Kitts, W. I	In American House, Liverpool Row	[b] $288.00	Observatory platform and storage.
172	Bridgetown, Barbados, W. I.	In Ice House, corner McGregor and Broad streets	[b] 352.00	Cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, soap, and towels.
173	Cienfuegos, Cuba, W. I	In Union Hotel, 19 D'Clouet street, corner San Fernando	[b] 480.00	Janitor, light, water, washing towels, and use of roof.
174	Habana, Cuba, W. I	At 67 Prado, Belots Baths	[b] 1,020.00	Cleaner, light, water, and soap.
		In Hacienda, between Obispo and Obripia streets		
175	Kingston, Jamaica, W. I	Halfway Tree, 3 miles north of Kingston	[b] 438.00	Water rates, taxes, and exposure instruments.
176	Puerto Principe, Cuba, W. I.	In San Francisco College, San Francisco Square	[b] 300.00	Janitor service and water.
177	San Juan, Porto Rico, W. I.	5 Allen street	[a] 600.00	Water.
178	Santiago de Cuba, Cuba, W. I.	In Provincial Institute, on Trinidad street		
		On left side of military road, near south entrance to city	[b] 324.00	
179	Santo Domingo, S. D., W. I	In Vicini Building, 7 Santo Tomas street	[a] 480.90	
180	Willemstad, Curaçao, W. I	In Washington Villa, on Hoogstraat	[b] 341.40	Cleaner, electric light, water, ice, and bridge tolls.
	Total		4,623.40	

[a] In accordance with existing lease.

[b] Under written agreement, lease being impracticable.

REPORT OF THE LIBRARIAN.

U. S. Department of Agriculture,
Office of the Librarian,
Washington, D. C., September 30, 1902.

Sir: I have the honor to submit herewith the executive report of the Library for the fiscal year ended June 30, 1902.

Respectfully,

Josephine A. Clark,
Librarian.

Hon. James Wilson, *Secretary.*

WORK OF THE YEAR.

ACCESSIONS TO THE LIBRARY.

The number of accessions to the Library for the year ended June 30, 1902, has exceeded that of any previous year. The number of books and pamphlets acquired by purchase and gift has been considerably over 4,000, making the total number of publications in the Library, exclusive of United States Government publications, nearly 75,000. In this number are not included parts of serials and issues of newspapers, which would add many thousand pieces. The principal purchases have been made in the direction of scientific periodicals, both in completing imperfect series and in subscriptions to those currently published, although many valuable works in natural science of early and recent date have also been acquired. Appended to this report is a selected list of some of the most important purchases during the year.

PERIODICALS.

The number of agricultural papers and scientific periodicals and serial publications has been largely increased the past year by new subscriptions, and, especially, by gifts and exchanges. About 2,200 publications of this class of accessions are currently received, of which 500 are purchased. The agricultural papers number 427, the greater number being contributed by the publishers. These papers include 210 general farm papers, 49 devoted to horticulture, 71 to live stock, 51 to poultry, 25 to dairy, 12 to tobacco, and 9 to farm machinery. The countries contributing these papers are, United States 275, and foreign countries 152. These papers, representing the agricultural interests of all parts of the United States and 38 foreign countries, are kept on file for public reference, and on completion of volumes, they are bound and become a part of the permanent collection of the Library.

The accessions to the Library of serials relating to agriculture and the kindred sciences continue to be the most numerous, and, from the nature of the work of the Department, the most valuable.

MAILING LISTS AND FOREIGN EXCHANGES.

For several years the foreign mailing lists of the Department publications have been in charge of the Library. These lists include all the foreign addresses to which the publications of twenty Bureaus and Divisions of the Department are regularly sent. During the past year these lists have been carefully revised and cut down, as far as possible, to addresses of such institutions as are working along similar lines as the Department, and as are sending their publications in exchange. The great number of publications issued by the Department and the increasing demand for them from foreign countries makes this an important branch of the Library work. The foreign publications received in exchange for the Department publications are chiefly scientific serials, and form a very large percentage of this class of accessions to the Library. The Library is thus enabled to complete imperfect series of periodicals, as well as to acquire a large number of new ones.

CATALOGUE.

The regular cataloguing of current accessions has been kept up to date during the year, adding many thousand cards to the catalogue. There have been added also to the catalogue printed cards purchased of the Library of Congress and printed cards for current botanical literature. A second contribution to the printed subject-catalogue of the Library has been completed, entitled "Catalogue of publications relating to botany in the Library of the United States Department of Agriculture." The collection of botanical works represented in this catalogue is one of the largest in the country and includes many rare and valuable publications. The increase of the number of cataloguers for the coming year will further the work of the printed subject-catalogues, and will thus facilitate the reference use of special collections.

PUBLICATIONS.

The Library bulletins and "Card index to the Department publications" have continued to be issued as heretofore. The bulletins have included the quarterly accessions to the Library, and two publications entitled, respectively, "Catalogue of publications relating to botany in the Library of the United States Department of Agriculture," and "List of references to publications relating to irrigation and land drainage." The former of these two special bulletins comprises 2,574 entries, representing nearly 6,000 books and pamphlets on the subject of botany. The latter bulletin includes 1,778 references to books and periodicals relating to irrigation and land drainage. The six bulletins published during the year comprise 573 printed pages.

The demand for the "Card index of the Department publications" continues. The early issues of the index on large cards are already exhausted, and it will be desirable to reprint these issues at an early date.

The "Card index of the Department publications" now numbers 1,600 cards, furnishing an author and a subject index to the Yearbooks for 1894 to 1900; the Farmers' Bulletins, 1 to 141; Special reports of the Division of Accounts, 1894 to 1898; Bulletins 1 to 6

and Circulars 1 to 7 of the Division of Soils; Bulletins 1 to 24 and Circulars 1 to 30 of the Division of Agrostology; Bulletins 1 to 24 and Circulars 1 to 29 of the Division of Botany, and the Contributions from the National Herbarium, volumes 1 to 5. Three hundred and sixty-five sets of these cards are printed, the greater number of which are distributed to the libraries of agricultural colleges and experiment stations and to public libraries which are depositories for Government documents. The contents of the publications of the Department are made much more available for use in these libraries by means of these index cards, and consequently they are valued additions to catalogues for public use.

BINDING.

The number of books bound the last year has been unusually large. The number of volumes of periodicals bound was 1,127, the number of separate publications 174, making a total of 1,301 volumes. The number of general works bound has been small on account of the necessity of first providing for the preservation of current periodicals by binding. Until larger funds are available for this work but few publications besides periodicals can be bound.

RECOMMENDATIONS.

With the large number of valuable accessions to the Library every year the need of a fireproof building becomes more imperative. The present collection of nearly 75,000 books and pamphlets, forming an invaluable working library for the Department, is in a building unsuited and unsafe for its care and protection. The destruction of any considerable part of the Library would be an inestimable loss, and, in addition, the delay to investigations caused thereby would be most serious. In view of the increasing value of the Library, it is earnestly recommended that special consideration be given to the provision of a safe building for this division of the Department work,

The new lines of investigation undertaken by the Department, together with the development of those continued from past years, have increased the demands for all available publications relating to the work in hand. Also, the establishment of special laboratories in different sections of the country has necessitated the purchase of expensive reference works for the advancement of these investigations. In order to promote these various lines of research and to meet new demands which can not be foreseen, a more nearly adequate appropriation should be made for the general expenses of the Library, from which all books for use in the Department are required to be purchased.

The bulletins and index cards published by the Library are desired by an increasing number of institutions each year. The editions of these publications are small, and, until a larger sum can be allotted from the general printing fund of the Department for Library publications, this branch of work will continue to fall short of the demands upon it. The requests for the index cards to the publications of the Department are especially numerous, and as many of the applicants express a willingness to pay for the cards in order to secure them, I would suggest that a nominal price be placed upon the cards distributed outside the present list of agricultural colleges and experiment stations and depository libraries, the moneys thus received to be added to the general printing fund of the Department. These receipts would contribute somewhat to defraying the cost of larger editions ot the Library publications.

IMPORTANT PURCHASES DURING THE FISCAL YEAR ENDING JUNE 30, 1902.

Bailey, Liberty Hyde, editor. Cyclopedia of American horticulture. v. 4. 1902. (Completes the work.)

Barla, Giambattista (Jean-Baptiste). Flore mycologique illustrée; les champignons des Alpes-Maritimes avec l'indication de leurs propriétés utiles ou nuisibles. fasc. 1–6. 1888–92.

Bennett, John Joseph. Plantæ Javanicæ rariores, descriptæ iconibus illustratæ, quas in insula Java, annis 1802–1818, legit et investigavit Thomas Horsfield, etc. 1838–52.

Berryat, J. Collection académique, composée des mémoires . . . des plus célèbres académies . . . concernant l'histoire naturelle et la botanique, etc. 13 v. 1755–79.

Bertolini, Antonio. Flora Italica. 10 v. 1833–54.

Blanchard, Emile, and Brullé, Auguste. Insectes de l'Amérique Méridionale. 1837–43.

Bonanni, Philippo. Rerum naturalium historia, nempe quadrupedum, insectorum, piscium, variorumque marinorum corporum, fossilium, plantarum exoticarum ac præsertim testaceorum, etc. 1723.

Bonaparte, Charles L. Iconografia della fauna italica. 3 v. 1832–41.

Bresadola, G. Fungi Tridentini novi, vel nondum delineati, descripti, et iconibus illustrati. v. 1–2. fasc. 1–14. 1881–1900.

Brookshaw, George. Pomona Britannica; or, A collection of the most esteemed fruits at present cultivated in Great Britain. 2 v. 1817.

Clusius, Carolus. Rariorum plantarum historia. 1601.

Cooke, Mordecai Cubitt. Illustrations of British fungi, Hymenomycetes, to serve as an atlas to the "Handbook of British fungi." 8 v. 1881–91.

Curtis, George. British entomology; being illustrations and descriptions of the genera of insects found in Great Britain and Ireland. 16 v. 1824–39.

Cuvier, G. L. C. F. D. Animal kingdom arranged according to its organization. 1834.

Démidoff, Anatole de. Voyage dans la Russie méridionale et la Crimée, sur la Hongrie, la Valachie et la Moldavie. 6 v. 1840–42.

Friedberger, Franz, and Fröhner, Eugen. Pathology and therapeutics of domestic animals. 2 v. [1894.]

Fries, Elias Magnus. Icones selectæ Hymenomycetum nondum delineatorum. v. 1. 1867–[75].

Fries, Elias Magnus. Sveriges ätliga och giftiga svampar tecknade efter naturen. 1861.

Geoffroy St.-Hilaire, Étienne. Tableau des quadrumanes, ou des animaux composant le premier ordre de la classe des mammifères. (1812.)

Geoffroy St.-Hilaire, Isidore. Descriptions des collections de Victor Jacquemont; mammifères et oiseaux. 1842–43.

Gervais, Paul. Zoologie et paléontologie françaises, animaux vertébrés. 3 v. in 1. 1848–52.

Harcourt, Leveson Francis Vernon-. Rivers and canals; the flow, control, and improvement of rivers, and the design, construction, and development of canals. Ed. 2, enl. 2 v. 1896.

Harriman Alaska expedition. Alaska. 2 v. 1901.

Herbst, Johann Friedrich Wilhelm. Kurze einleitung zur kenntniss der insekten. 3 v. 1784–87.

Hermann, Jean Frédéric. Mémoire aptérologique. 1804.

Hermann, Johann. Tabula affinitatum animalium, olim academico specimine edita, nunc uberiore commentario illustrata cum annotationibus, etc. 1783.

Hogg, Robert, editor. Herefordshire pomona, containing coloured figures and descriptions of the most esteemed kinds of apples and pears. 2 v. (7 pts.). 1876–85 [1878–84.]

Hooker, William. Pomona Londinensis; containing colored engravings of the most esteemed fruits cultivated in the British gardens. v. 1. 1818.

Jäger, Gustav, and others, editors. Handwörterbuch der zoologie, anthropologie und ethnologie. 8 v. 1880–1900.

Knight, Thomas Andrew, compiler. Selection from the physiological and horticultural papers, published in the transactions of the Royal and Horticultural societies. 1841.

Law, James. Text book of veterinary medicine. 3 v. 1896–1901.

Lindley, John. Pomologia Britannica; or Figures and descriptions of the most important varieties of fruit cultivated in Great Britain. 3 v. 1841.

Linnæus, Carl von. Flora Lapponica, exhibens plantas per Lapponiam crescentes. 1737.
Low, David. Breeds of the domestic animals of the British Islands. 2 v. in 1. 1842.
Lucas, Pierre Hippolyte. Animaux nouveaux ou rares recueillis pendant l'expédition dans les parties centrales de l'Amérique du Sud. . . . exécutée . . . sous la direction du comte de Castelnau. Entomologie. 1857.
Mawson, Thomas H. Art and craft of garden making. 1901.
Murray, James Augustus Henry, editor. New English dictionary on historical principles. v. 1–5. 1888–1901.
Nees von Esenbeck, Christian Gottfried. Das system der pilze und schwämme. 1816.
Oken, Lorenz. Lehrbuch der naturgeschichte. 3 theile. 1813–26.
Wanting, theil 2 (Botanik), abt. 1.
Patouillard, Narcisse. Tabulæ analyticæ fungorum. ser. 1, fasc. 1–5; ser. 2, fasc. 6–7. 1883–89.
Pomeroy, John Norton. Treatise on the law of water rights as the same is formulated and applied in the Pacific States. 1893.
Royal horticultural society, London. A catalogue of the fruits cultivated in the garden of the Horticultural society of London. Ed. 3. 1842.
Schäffer, Jakob Christian. Fungorum qui in Bavaria et Palatinatu circa Ratisbonam nascuntur icones; editio nova commentario aucta a C. H. Persoon. 4 v. 1800.
Stoll, Casper. Natuurlyke . . . gekleurde afbeeldingen en beschryvingen der Cicaden. 1788.
Theobald, Frederick Vincent. Monograph of the Culicidæ or mosquitoes. 3 v. 1901.
Villon, A. M., and Guichard, P., compilers. Dictionnaire de chimie industrielle, contenant les applications de la chimie. fasc. 1–32. [1892–1902.]

PERIODICALS.

American journal of physiology. v. 1–6. 1898–1902.
Annals of philosophy; or, Magazine of chemistry, mineralogy, mechanics, natural history, agriculture, and the arts. v. 1–28. 1813–26. (All published.)
Beiträge zur wissenschaftlichen botanik. v. 2–4. 1898–1901. (File completed.)
Botanisches centralblatt. v. 1–36. 1880–88. (File completed.)
Bulletin zoologique. année 1835. (All published.)
Deutsche entomologische zeitschrift. v. 1–13. 1884–99.
Edwards's botanical register. v. 1–33. 1815–47. (All published.)
Flora; oder, Allgemeine botanische zeitung. v. 1–85. 1818–98. (File completed.)
Jahrbuch der naturgeschichte. v. 1. 1802. (All published.)
Journal de botanique. v. 1. 1808–[09]. (All published.)
Liége (Belgium), Société royale des sciences de. Mémoires. v. 1–16. 1843–61.
Lindenia, iconographie des orchidées. v. 1–16. 1885–1900.
Linnæa, ein journal für die botanik in ihrem ganzen umfange. v. 1–43. 1826–82. (All published.)
Revue de l'horticulture belge et étrangère. v. 11–27. 1885–1901. (File completed.)
Revue de viticulture, organe de l'agriculture des régions viticoles. v. 4–14. 1895–1900. (File completed.)
Revue entomologique, publiée par Gustave Silbermann. 5 v. 1833–37. (All published.)
Sociedade Broteriana. Boletim. v. 1–13. 1883–96. (File completed.)
Zeitschrift für physiologische chemie. v. 1–5. 1877–81. Sach- und namenregister zu band 1–4. 1881. (File completed.)
Zeitschrift für veterinärkunde. v. 1–10; v. 12, no. 11. 1889–1900. (File completed.)

REPORT OF THE DIRECTOR OF THE OFFICE OF EXPERIMENT STATIONS.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., September 20, 1902.

Sir: I have the honor to present herewith the report of the Office of Experiment Stations for the fiscal year ended June 30, 1902.

Respectfully,

A. C. True,
Director.

Hon. James Wilson, *Secretary.*

WORK OF THE YEAR, WITH RECOMMENDATIONS.

Division and Development of Work of Office of Experiment Stations.

The functions of the Office of Experiment Stations have been enlarged in several directions during the past year and the enterprises previously in its charge have become more extensive. Especial efforts have been made to aid the movement for the strengthening of agricultural education and research through the more definite formulation of agricultural science and the more thorough training of agricultural experts. For this purpose the work of this Office, in connection with the Graduate School of Agriculture, as described elsewhere in this report, has proved to be unusually successful and effective. Attempts have also been made to call the attention of the agricultural public and the managers of educational systems to the great desirability of making agricultural subjects a part of the curriculum of secondary and elementary schools. The development of the farmers' institutes as effective agencies for the dissemination of the results of the work of this Department and the experiment stations has also engaged our attention. The agricultural experiment stations under the direct management of this Office in Alaska, Hawaii, and Porto Rico have been put upon a firm basis, and much progress has been made in developing useful lines of work in these regions. The Office has been brought into closer relations with the institutions for agricultural research in foreign countries through work involved in the preparation of a bulletin setting forth the organization, resources, and lines of work of these institutions. By this means our knowledge of these foreign institutions has been greatly broadened, and it will be more feasible hereafter to secure definite information regarding their work which will be useful to similar institutions in this country. Both the legal and engineering features of the irrigation investigations

have been enlarged, and a beginning has been made of investigations in other lines of agricultural engineering which have hitherto been neglected by this Department. Improvements have been made in the apparatus and methods for nutrition investigations. The results of these investigations have been more effectively brought to the attention of teachers of physiology and domestic science, and beginnings have been made of what it is hoped may develop into a systematic study of dietaries in public institutions.

The amount of material prepared for publication during the year has been greater than in any previous year. Special efforts have been made to publish this material in forms which will contribute to its effective and economical distribution. The Office has continued to perform considerable labor in connection with expositions, and has in prospect the continuance of such work in connection with the St. Louis Exposition. The performance of duties growing out of the relations of the Department with the Civil Service Commission has also involved considerable work. With the constant and rapid growth of the system of agricultural education and research in this and other countries the general business of the Office in its relations with outside institutions is necessarily enlarged from year to year. To meet the growing demands on the Office in different directions, I recommend that the appropriation for the maintenance of this Office for the fiscal year 1904 be increased to $40,000.

In order to make the organization of the Office conform more closely to that of other branches of the Department having complex functions, as well as to more definitely recognize its rank as equal to that of a bureau, some changes have, by direction of the Secretary, been made in the plan of organization previously followed. At present the division and assignment of the work of the Office are as follows: (1) Relations with American and foreign institutions for agricultural education and research, including the supervision of the expenditures of the agricultural experiment stations in the United States, in the immediate charge of the Director. (2) The Experiment Station Record, in charge of the Assistant Director, Dr. E. W. Allen. (3) Editorial division, Mr. W. H. Beal, chief. This division has in charge the editing of the technical and popular publications of the Office other than the Experiment Station Record. (4) Division of insular experiment stations, Dr. Walter H. Evans, chief. This division is charged with the general business relating to the following experiment stations: (*a*) Alaska agricultural experiment stations, in charge of Prof. C. C. Georgeson, with headquarters at Sitka; (*b*) Hawaii Agricultural Experiment Station, in charge of Mr. Jared G. Smith, with headquarters at Honolulu; (*c*) Porto Rico Agricultural Experiment Station, in charge of Mr. Frank D. Gardner, with headquarters at Mayaguez. (5) Nutrition investigations, Prof. W. O. Atwater, chief, with headquarters at Middletown, Conn. (6) Irrigation investigations, Prof. Elwood Mead, chief, and Mr. C. T. Johnston, assistant chief.

The position of chief clerk of this Office has been created and is filled by Mrs. C. E. Johnston.

Relations with American and Foreign Institutions for Agricultural Education and Research.

The general features of the work of the Office involved in its relations with American and foreign institutions for agricultural educa-

tion and research, in immediate charge of the Director, have remained essentially as heretofore and may be conveniently described under the following heads: (*a*) Agricultural experiment stations in the United States; (*b*) American institutions for agricultural education; (*c*) Association of American Agricultural Colleges and Experiment Stations; and, (*d*) foreign institutions for agricultural education and research.

AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

ADVISORY RELATIONS WITH THE STATIONS.

The advice and assistance of this Office in many matters relating to the organization, equipment, and work of the stations continue to be sought in a large measure. In particular the personal conferences between station officers and representatives of this Office have increased in number and importance. This has enabled the Office to get a more thorough understanding of the problems of station work and to bring its influence more directly to bear on the development of the station enterprise.

The feature of the progress of agricultural institutions in this country which has attracted most attention during the past year is the rapid increase in the public interest in these institutions. This is shown in the increase in the number of students in the agricultural colleges and schools, in the larger attendance at the farmers' institutes, in the enlarged correspondence and mailing lists of the stations, in the increased demand for trained workers in agricultural and other business enterprises requiring scientific and expert knowledge and skill for their most successful management, and in the wider space given to agricultural education and research in agricultural and other journals.

So rapidly has the demand for the services of agricultural experts spread in different directions that the workers in this service have in many instances been overworked, or at least have been forced to dissipate their energies in attempts to cover too many fields. There is therefore a most urgent necessity that the number of workers in our agricultural institutions should be increased so as to permit proper specialization of work. The station investigators must be relieved of teaching, lecturing at farmers' institutes, and other services which, while important in themselves, distract their attention, dissipate their energies, and seriously hinder the progress of effective investigations.

It will be of little use to construct expensive laboratories and equip them with elaborate apparatus unless they are manned with first-class investigators. There is nothing new in this proposition, but the progress of agricultural institutions in this country in recent years makes it imperative that the work of the experiment stations and of this Department as the source of new knowledge on agricultural problems should be raised to the highest grade and kept there. The wider the work of the agricultural colleges, schools, farmers' institutes, and other agencies for the education of our rural population becomes, the more important is it that the institutions of research in agriculture should be the best that human wisdom can devise. It is now necessary to insist on this more strongly than ever before, and it will be necessary to reiterate it until the managers of agricultural institutions and the friends of agricultural progress accept this principle in practice as well as in theory. Under present conditions a large number

of the experiment-station workers are attempting too many different kinds of work, and the progress of the stations is seriously hindered from this cause.

One result of the lack of a sufficient number of well-trained and experienced workers in our agricultural institutions is that the best men are constantly being shifted from one institution to another, or are departing to outside enterprises offering larger salaries and other attractions. The past year has witnessed an unusually large number of such changes in the personnel of the experiment stations. This is a very serious matter, since the time element in the conduct of agricultural investigations is an important one. Until the tenure of office in our stations is much more stable than at present, we must expect that there will be much waste of work and funds in incomplete investigations due to the frequent shifting of the officers in charge.

There is also need of increased funds for the general expenses connected with agricultural investigations. This is well stated in a recent editorial by Dr. Allen in the Experiment Station Record, as follows:

> The demands made upon the station for its services in a variety of directions have necessitated broadening and extending its work, until in many States it has reached the extreme limit which the present funds will allow. In not a few cases we have more departments than there are funds for, so that a part of them are stifled and held down to the sheerest necessities. Moreover, the character of the work of the stations is gradually undergoing a change. The simpler and more superficial problems in many lines of agriculture have been solved to a large extent, and demonstrated beyond doubt. The more complex and intricate investigations, involving deeper and more time consuming research, will be the field more largely occupied by the leading stations in the future. Some have already entered it, and others are being stimulated and led on by their example. This means a more specialized station staff, assigned primarily to station work. There is a gradual tendency in that direction, and any movement in the direction of increasing the duties of station workers in elementary instruction is unmistakably to be regarded as a retrograde movement.
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> These conditions, as well as the more expensive plants of the stations, call for larger means for general maintenance; and this need is becoming imperative if the stations are to continue to advance in accordance with the demands which their popularity has brought about. Fortunately, progress is being made in that direction, and State appropriations for special lines of investigations are increasing every year.

Progress has been made during the past year in the differentiation of the equipment and work of the experiment stations as distinct departments of the agricultural colleges, and the movement for the separation of the office of director of the station from that of president of the college or university is continuing. In only nine States and Territories does the college president now perform the functions of director of the experiment station.

It is very clear that farmers in different parts of the country are coming to understand the importance of the work of the stations, and are recognizing the practical value of the results of this work by making actual use of them on their farms. There is also an encouraging understanding of the necessary limitations of station work. Intelligent farmers are coming to see that, while the stations may be of great assistance in the improvement of farm practice, the final result will not be to make farming a more simple business. A higher intelligence, more definite education, and greater thrift will hereafter be required to make successful farmers.

SUPERVISION OF EXPENDITURES.

The seventh annual examination of the work and expenditures of the agricultural experiment stations which receive the National funds

appropriated under the act of Congress of March 2, 1887 (Hatch Act), with special reference to the fiscal year ended June 30, 1901, was made during the past year in accordance with the authority conferred upon the Secretary of Agriculture by Congress, and a report of this investigation was prepared for transmission to Congress, as required by law. This report was published as House Doc. No. 334, Fifty-seventh Congress, first session.

As heretofore, the report was based upon three sources of information, viz, the annual financial statements of the stations, rendered on the schedules prescribed by the Secretary of Agriculture in accordance with the act of Congress; the printed reports and bulletins of the stations, and the reports of personal examinations of the work and expenditures of the stations made during the year by the Director, assistant director, and one other expert officer of the Office of Experiment Stations.

The following statements are taken from the report:

Problems of station organization.—Questions relating to the organization of the stations still continue to require the attention of the authorities charged with their management. In a number of States the organization and general attitude of the governing boards are not yet wholly satisfactory. For various reasons the boards of control as at present constituted are often not able to give close enough attention to the requirements of the stations to thoroughly understand the nature of their operations and the requisites for their most efficient work. This may be due to the frequent changes in the membership of the board, to infrequent and short meetings of the board, or to mistaken ideas on the part of the board of its proper functions. Under existing conditions no one effectual remedy for these evils is apparent. It may, however, be properly urged that the governors or other appointing officers in the several States should exercise great care in the selection of members of these boards, and should insist that they confine themselves chiefly to the selection of competent expert officers to have the direct management of the stations. It has been suggested that good might result from closer relations between this Office and the boards of control. This could be secured only by having representatives of the Office attend meetings of the boards. It is possible that an arrangement might be made by which a representative of the Office should visit each station annually at a time when the governing board is in session. This would, however, require a larger expense for traveling than is possible with the present resources of the Office.

Owing to the increased number of cooperative enterprises between the Department and the stations, it is more than ever important that the management of the stations should proceed on well-defined and permanent policies, and it may be that the Office could accomplish much good by cultivating closer relations with the boards of control. This matter should certainly be considered in the future plans of the operations of the Office.

Relation of salaries to other station expenses.—In planning the work of experiment stations a common mistake is to attempt work in too many different lines. This necessitates the employment of a considerable number of officers on the station staff, and thus unduly increases the salary roll. The result is that after the salaries and printing bills are paid, the remainder of the station income, when divided among the different officers charged with making the investigations, affords only a small sum for the general expenses of each investigation. This makes it necessary to conduct the individual investigations on so limited a scale that the results are either entirely unsatisfactory or do not offer a safe guide for practical application. Those stations have had the greatest success in their operations which have so limited the lines of work to their resources as to enable them to conduct investigations and then attempt in a thorough way to reduce the result to a practical basis. In a number of States the stations should either be given larger financial support or else they should contract their operations within narrower lines. Generally speaking, the relation of salaries to other expenses should receive the closer attention of governing boards and general officers of the station.

Dissemination of results of station work.—To disseminate the results of their work among our farmers the stations are issuing a great variety of publications and distributing them very widely. These publications not only include detailed accounts of their investigations, but also short summaries of the practical results

and compilations of information on a great variety of agricultural topics. They are also giving much attention to the dissemination of information through the agricultural press by means of press bulletins and special articles. The number of books prepared by officers of the agricultural colleges and experiment stations is constantly growing, and these range all the way from elaborate scientific treatises to very elementary and popular works.

Undoubtedly, much progress has been made in recent years in acquainting our farmers with the results of experiment station work, and it is obvious even to the superficial observer that the results of the work of the stations are being from year to year more generally applied on farms in different parts of the country.

But while this is true, there is still a great amount of ignorance regarding the work of the stations, and especially regarding the ways in which results obtained by the stations may be applied on the farm. While the spread of education and the spirit of progress among our farmers within the past few years has been very remarkable, there is still a mass of ignorance and false conservatism which in the aggregate constitutes a vast dead weight on our agriculture. As long as 100 out of every 1,000 men of voting age on our farms are unable to either read or write (as is shown to be the case by the census of 1900) it is not to be expected that the publication of the results obtained at our experiment stations through printed documents will suffice to meet the needs of our agricultural population regarding the progress of the art. Even those farmers who are accustomed to read ordinary books and newspapers are often not prepared to understand and appreciate the station publications because of lack of the necessary preliminary information. To supplement the station publications and bring the results of their work more directly home to the farmer, the stations have felt obliged to participate largely in the farmers' institutes now so generally held in many of our States. While this work has, strictly speaking, been outside their province, at least as determined by the Federal law under which most of them are organized, it has nevertheless been an efficient means of strengthening their position and securing the confidence and support of their farmer constituencies. The problem is, therefore, how to develop the farmers' institute movement in its relation to the stations so as to make the institutes more efficient and at the same time to prevent their interfering too much with the duties of station officers as investigators and writers.

Statistics of the stations.—Agricultural experiment stations are now in operation under the act of Congress of March 2, 1887, in all the States and Territories and in Alaska, Hawaii, and Porto Rico. In Connecticut, New Jersey, New York, Hawaii, Missouri, Alabama, and Louisiana separate stations are maintained wholly or in part by State funds. A number of substations are also maintained in different States. Excluding the substations, the total number of stations in the United States is 60. Of these, 54 receive appropriations provided for by act of Congress.

The total income of the stations during 1901 was $1,231,881.55, of which $720,000 was received from the National Government, the remainder, $511,881.55, coming from the following sources: State governments, $290,305.95; individuals and communities, $1,580.59; fees for analyses of fertilizers, $82,322.40; sales of farm products, $93,363.98; miscellaneous, $44,308.63. In addition to this, the Office of Experiment Stations had an appropriation of $125,000 for the past fiscal year, including $12,000 for the Alaska experiment stations, $10,000 for the Hawaiian investigations, $5,000 for the Porto Rican investigations, $15,000 for nutrition investigations, and $50,000 for irrigation investigations. The value of additions to the equipment of the stations in 1901 is estimated as follows: Buildings, $133,420.77; libraries, $26,303.49; apparatus, $15,309.48; farm implements, $13,085.45; live stock, $18,220.29; miscellaneous, $25,025.10—total, $231,364.58.

The stations employ 688 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work is as follows: Directors, 52; assistant and vice-directors, 17; chemists, 146; agriculturists, 62; animal husbandmen, 14; horticulturists, 78; farm foremen, 21; dairymen, 31; botanists, 49; entomologists, 48; zoologists, 6; veterinarians, 29; meteorologists, 14; biologists, 7; physicists, 5; geologists, 5; mycologists and bacteriologists, 21; irrigation engineers, 8; in charge of substations, 12; secretaries and treasurers, 29; librarians, 11; and clerks and stenographers, 43. There are also 77 persons classified under the head of "miscellaneous," including superintendents of gardens, grounds, and buildings; apiarists; vegetable, plant, and animal pathologists; herdsmen; poultrymen, etc.

Three hundred and twenty-five station officers do more or less teaching in the colleges with which the stations are connected.

The activity and success of the stations in bringing the results of their work

before the public continue unabated. During the year they published 445 annual reports and bulletins, which are many more than are required by the Hatch Act. These were supplied to over half a million addresses on the regular mailing lists. A larger number of stations than formerly supplemented their regular publications with more or less frequent issues of press bulletins, and most of the stations report a large and constantly increasing correspondence with farmers on a wide variety of topics.

During the year a number of new institutions for investigations in agriculture have been established. The Virginia State board of agriculture has established at Saxe, Charlotte County, an experimental farm for the purpose of making fertilizer tests in accordance with the State fertilizer law. The Mississippi legislature has appropriated $13,000 for a new substation which has been located at McNeill on a 2,000-acre tract of donated land. A new Texas substation, for which the State legislature appropriated $10,000, has been located at Troupe, in Smith County. The Kansas experiment station has finally come into possession of 3,500 acres of the Fort Hays Reservation and has established there a substation supported by State funds. The Agricultural Epitomist experiment station has been recently established at Spencer, Ind., on a farm of 500 acres, owned and conducted by the company which publishes the Agricultural Epitomist.

COOPERATION OF THE STATIONS WITH THE DEPARTMENT.

During the past year many cooperative enterprises between the different Bureaus and Divisions of this Department and the experiment stations have been continued and contracts have been made for a considerable number of new investigations on this plan. The methods of arranging and conducting such operations have been more clearly defined. As a result of experience, the following plan for arranging for cooperative work between the stations and the Department was formulated by the Secretary of Agriculture and communicated to the stations, as well as to the chiefs of the Department:

(1) The chiefs of the Bureaus or Divisions in the Department desiring cooperation with the stations shall bring the matter to the attention of the director or other proper officer of the station, outlining briefly the line of work it is intended to pursue, and suggesting the designation of someone in the station who can take up the preliminaries with the representative of the Bureau or Division and arrange matters for final action by the Department and the station authorities.

(2) As soon as all preliminaries are arranged, a draft of the agreement should be prepared and submitted for the approval of the Secretary of Agriculture on the one hand and the proper officer of the station on the other. Under this agreement, the responsibility of both the Department and the station being clearly set forth, the men who are to do the work will be free to carry it out in such manner as in their judgment may seem best, keeping, of course, clearly within the lines of the contract. By a general adoption of this plan many of the difficulties heretofore encountered can be overcome, and there will be in all cases a clearly defined understanding as to the responsibilities of all parties concerned.

(3) For the purpose of keeping the records complete, one copy of the signed agreement shall be filed with the chief of the Bureau or Division cooperating and another with the director or proper officer of the station, and copies of all agreements shall also be furnished to the Office of Experiment Stations, this Department, and to the men in both the station and the Bureau who are to carry out the work.

As the number of calls for cooperative work have increased, it has become clear that in many instances the limited funds of the stations will not permit them to give any direct financial support to any considerable number of such enterprises. The only contribution they are often able to make is the limited service of officers already largely

engrossed in other work, and in some cases office and laboratory facilities. The proper adjustment of the financial obligations necessarily involved in the cooperative enterprises between the Department and the stations is a problem which still requires much careful consideration.

Summary of cooperative enterprises between the Department and the colleges and stations.

Station.	Bureau, Office, or Division.	Line of work.
Alabama	Plant Industry	Tests of novelties introduced by seed trade.
Arizona	Plant Industry	Investigations on the improvement of desert ranges.
	Chemistry	Influence of environment on the sugar content of muskmelons.
	Soils	Soil survey.
California	Plant Industry	Planting and testing of soil and sand-binding plants.
	Chemistry	Investigation of the gluten content of wheat.
	Chemistry	Sugar-beet investigations.
	Experiment Stations	Nutrition investigations.
	Experiment Stations	Irrigation investigations.
Colorado	Plant Industry	Growing of sugar-beet seed.
	Plant Industry	Forage crops for alkali and arid soils.
	Chemistry	Sugar-beet investigations.
	Chemistry	Available plant food in soils.
	Chemistry	Investigation of the gluten content of wheat.
	Soils	Soil survey.
	Experiment Stations	Irrigation investigations.
Connecticut (State)	Plant Industry	Tests of novelties introduced by seed trade.
	Soils	Tobacco investigations.
	Forestry	Tree-planting experiments.
Connecticut (Storrs)	Experiment Stations	Nutrition investigations.
Delaware	Plant Industry	Cover crops for orchards.
	Chemistry	Influence of environment on sugar content of muskmelons.
Florida	Plant Industry	Tests of novelties introduced by seed trade.
	Chemistry	Available plant food in soils.
Georgia	Experiment Stations	Nutrition investigations.
Idaho	Plant Industry	Tests of novelties introduced by seed trade.
	Soils	Soil survey.
Illinois	Plant Industry	Growing of sugar-beet seed.
	Plant Industry	Tests of novelties introduced by seed trade.
	Chemistry	Available plant food in soils.
	Soils	Soil survey.
Indiana	Plant Industry	Tests of novelties introduced by seed trade.
	Chemistry	Sugar-beet investigations.
	Chemistry	Influence of environment on the sugar content of muskmelons.
	Chemistry	Investigation of the gluten content of wheat.
	Soils	Soil survey.
Iowa	Plant Industry	Cereal investigations.
	Plant Industry	Tests of novelties introduced by seed trade.
	Animal Industry	Sheep-breeding investigations to produce type better suited to range conditions.
	Chemistry	Available plant food in soils.
	Soils	Soil survey.
Kansas	Plant Industry	Tests of novelties introduced by seed trade.
	Plant Industry	Cereal investigations.
	Plant Industry	Pasture and range improvement—grasses and forage plants for arid lands.
	Chemistry	Available plant food in soils.
Kentucky	Plant Industry	Rotation of crops, farm management, including tests of novelties introduced by seed trade; methods of establishing and maintaining permanent pastures.
	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Chemistry	Sugar-beet investigations.
	Chemistry	Investigation of the gluten content of wheat.
	Chemistry	Influence of environment on the sugar content of muskmelons.
	Chemistry	Available plant food in soils.
Louisiana	Plant Industry	Growing and studying sweet potatoes.
Maine	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Chemistry	Available plant food in soils.
	Experiment Stations	Nutrition investigations.
Maryland	Plant Industry	Cereal investigations.
	Plant Industry	Influence of origin of red clover seed on yield of crop.

Summary of cooperative enterprises between the Department and the colleges and stations—Continued.

Station.	Bureau, Office, or Division.	Line of work.
Maryland	Plant Industry	Best crops for use in securing a continuous soiling series for dairy and farm stock.
	Chemistry	Investigation of the gluten content of wheat.
	Chemistry	Influence of environment on sugar content of muskmelons.
	Soils	Soil survey.
Michigan	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Plant Industry	Best grasses for fixing drifting sands.
	Plant Industry	Growing of sugar-beet seed.
	Chemistry	Sugar-beet investigations.
	Chemistry	Investigation of the gluten content of wheat.
	Chemistry	Available plant food in soils.
	Soils	Soil survey.
Minnesota	Plant Industry	Cereal investigations, forage and other crops.
	Chemistry	Available plant food in soils.
	Statistics	Statistics relating to cost of growing fields, crops, and to farm management.
	Soils	Soil survey.
	Experiment Stations	Nutrition investigations.
Mississippi	Soils	Soil survey.
Missouri	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Plant Industry	Formation and management of meadows and pastures.
	Chemistry	Available plant food in soils.
	Chemistry	Investigation of the gluten content of wheat.
	Soils	Soil survey.
	Experiment Stations	Irrigation investigations.
Missouri State Fruit	Plant Industry	Bitter rot of apples.
Montana	Experiment Stations	Irrigation investigations.
Nebraska	Plant Industry	Influence of environment on plants, etc.
	Plant Industry	Best grasses and forage plants for meadows and pastures.
	Experiment Stations	Irrigation investigations.
Nevada	Experiment Stations	Irrigation investigations.
New Hampshire	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Plant Industry	Tests of novelties introduced by seed trade.
New Jersey	Soils	Soil survey.
	Experiment Stations	Irrigation investigations.
New Mexico	Plant Industry	Best crops for supplying forage to supplement natural ranges and for the improvement of cultivated lands.
	Chemistry	Available plant food in soils.
	Soils	Soil survey.
	Experiment Stations	Irrigation investigations.
New York (State)	Animal Industry	Curing of cheese at low temperatures.
	Plant Industry	Growing of sugar-beet seed.
	Chemistry	Sugar-beet investigations.
New York (Cornell)	Chemistry	Sugar-beet investigations.
North Carolina	Plant Industry	Best grasses and forage plants for meadows and pastures.
	Chemistry	Influence of environment on the sugar content of muskmelons.
	Chemistry	Available plant food in soils.
	Soils	Soil survey.
North Dakota	Plant Industry	Cereal investigations and forage and other crops.
	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Chemistry	Available plant food in soils.
	Soils	Soil survey.
Ohio	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Chemistry	Available plant food in soils.
	Soils	Soil survey.
Oregon	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Plant Industry	Best grasses for fixing drifting sands.
	Chemistry	Available plant food in soils.
Pennsylvania	Animal Industry	Investigations in animal nutrition, involving construction of a respiration calorimeter.
	Soils	Tobacco investigations.
Porto Rico	Soils	Soil survey.
South Carolina	Chemistry	Available plant food in soils.
South Dakota	Plant Industry	Cereal investigations and forage and other crops.
	Plant Industry	Renewing worn-out pasture lands and best grasses and forage plants for arid lands.
	Chemistry	Available plant food in soils.
	Experiment Stations	Irrigation investigations.

Summary of cooperative enterprises between the Department and the colleges and stations—Continued.

Station.	Bureau, Office, or Division.	Line of work.
Tennessee	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Plant Industry	Cereal investigations, grass, forage plants, and other crops.
Texas	Plant Industry	Grasses and forage plants best for meadow and pasture purposes.
	Plant Industry	Cereal investigations.
	Soils	Soil survey.
	Experiment Stations	Irrigation investigations.
Utah	Plant Industry	Grasses and forage plants for arid and alkali soils.
	Chemistry	Available plant food in soils.
	Chemistry	Sugar-beet investigations.
	Soils	Alkali soils, seepage, and drainage investigations.
Vermont	Plant Industry	Drug-producing plants.
	Plant Industry	Best pasture and meadow grasses for wet lands.
	Chemistry	Available plant food in soils.
	Experiment Stations	Nutrition investigations.
Virginia	Chemistry	Sugar-beet investigations.
	Chemistry	Methods of manufacture of cider.
	Chemistry	Available plant food in soils.
	Soils	Soil survey.
Washington	Plant Industry	Drug-producing plants.
	Plant Industry	Cereal investigations and forage and other crops.
	Plant Industry	Improvement of the Northwestern ranges.
	Chemistry	Available plant food in soils.
	Experiment Stations	Irrigation investigations.
West Virginia	Plant Industry	Influence of various combinations on the three important elements of plant food—nitrogen, potash, and phosphoric acid.
Wisconsin	Animal Industry	Curing of cheese at low temperatures.
	Chemistry	Sugar-beet investigations.
	Chemistry	Available plant food in soils.
	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Plant Industry	Cereal investigations and forage and othe crops.
	Experiment Stations	Irrigation investigations.
Wyoming	Plant Industry	Grasses and forage plants for alkali soils.
	Chemistry	Sugar-beet investigations.
	Chemistry	Available plant food in soils.
	Experiment Stations	Irrigation investigations.

The Division of Entomology cooperates with the stations generally in a number of different ways, including the frequent identification of material, studies of life histories of insects, and the means for their control. Among the special lines of cooperative effort during the past year have been those relating to the introduction of beneficial foreign insects, the South African grasshopper disease fungus, the Mexican cotton-boll weevil, the codling moth, insects injurious to forest trees, and the relation of insects to the health of man.

EXPERIMENT STATION EXHIBITS AT EXPOSITIONS.

The experiment station exhibit made at the Buffalo Pan-American Exposition of 1901 was transferred to the South Carolina Interstate and West Indian Exposition, at Charleston, S. C., in the fall of that year, and at the close of that exposition was returned to Washington. The Association of American Agricultural Colleges and Experiment Stations, at its convention in Washington in 1901, voted in favor of an exhibit showing the progress of agricultural education and research at the Louisiana Purchase Exposition in St. Louis in 1904, and a committee, of which the Director of this Office is a member, was appointed to have charge of this exhibit. If this plan is carried out considerable work in connection with the exhibit will doubtless be imposed on this

Office, thus continuing exposition work as a somewhat regular function of the Office, for which provision has to be made.

AMERICAN INSTITUTIONS FOR AGRICULTURAL EDUCATION.

GRADUATE SCHOOL OF AGRICULTURE.

A new enterprise in agricultural education has been inaugurated by the establishment of the Graduate School of Agriculture, which held a four weeks' session during the month of July, 1902, at the Ohio State University, Columbus, Ohio. The plan for this school was originated by Prof. Thomas F. Hunt, dean of the College of Agriculture and Domestic Science of the Ohio State University, the purpose being to establish a school for advanced students of agriculture at which leading teachers and investigators of the agricultural colleges and experiment stations and of this Department should present in some regular way summaries of the recent progress of agricultural science, illustrate improved methods of teaching agricultural subjects, and afford a somewhat extended opportunity for the discussion of live topics drawn from the rapidly advancing science of agriculture. This idea received the cordial approval of President Thompson, of the Ohio State University, and on the recommendations of these two men the board of trustees of the university voted to establish such a school and generously made provision for the financial support of its first session.

The Association of American Agricultural Colleges and Experiment Stations at its convention in 1901 favored the plan for the school and voted that, if the success of the first session seemed to justify its continuance, it be made a cooperative enterprise under the control of the association. The Secretary of Agriculture also expressed his cordial approval of this movement, and, on his advice, the Director of the Office of Experiment Stations consented to act as dean, and other officers of the Department of Agriculture to be members of its faculty. Under these favorable auspices, there was little difficulty in securing a strong faculty. As actually organized, this included 35 men, of whom 26 are professors in agricultural colleges, 7 are leading officers of the Department of Agriculture, and 2 are officers of the New York State Experiment Station. Courses were offered in agronomy, zootechny, dairying, and breeding of plants and animals. The school was housed in the substantial and well-equipped agricultural building of the university, where were illustrated the most improved apparatus for instruction in soil physics, dairying, and other agricultural subjects. Besides the live stock of the university farm, leading breeders of Ohio furnished choice animals for the stock-judging exercises.

General problems of agricultural science and pedagogy were discussed at the inaugural exercises and at Saturday morning conferences. Among the topics thus treated were the history of agricultural education and research in the United States; the organization of agricultural education in colleges, secondary schools, nature-study courses, correspondence courses, farmers' institutes, and various forms of university extension; what constitutes a science of agriculture; methods and values of cooperative experiments. Through social assemblies, visits to typical Ohio farms, and much informal discussion wherever the students met each other, the educational influences of the school were greatly extended. Seventy-five students were in attendance. These were drawn from 28 States and Territories, includ-

ing such widely-separated regions as Maine, Oregon, California, New Mexico, and Alabama. There was one student from Canada and one from Argentina. There was also one woman, and the colored race was represented by teachers from the Tuskegee Institute and the agricultural college at Greensboro, N. C. Twenty-seven of the students are professors or assistant professors of agriculture in agricultural colleges, 31 are assistants in the agricultural colleges and experiment stations, 9 are recent college graduates, and 8 are engaged in farming.

Considering the character of the faculty and students, it goes without saying that the whole period of the session was occupied with the most earnest and profitable work. Without doubt, the influence of this school will be felt throughout the country in the improvement of courses of instruction in agriculture and the strengthening of the lines and methods of investigation of agricultural subjects. In other ways the school will exert a beneficial influence. So rapid has been the accumulation of materials for a real science of agriculture during the past few years that even professional students of agriculture have not realized how large a mass of knowledge is already available for molding into a systematic body of truth which may be utilized for pedagogic purposes, as well as for inductions of scientific and practical value. The summaries given by the experts gathered at this graduate school have emphasized this fact and shown in a striking manner that agricultural education and research may now be properly and efficiently organized with reference to the science of agriculture itself, rather than be, as heretofore, very largely a matter of the sciences related to agriculture. This will serve to stimulate greatly the movement already begun for the reduction of the materials of agricultural science to "pedagogic form" for use in colleges and secondary schools, and for the reorganization of agricultural institutions of research on the basis of the divisions and subdivisions of agriculture, instead of physics, chemistry, botany, and other primary and secondary sciences. The day will thus be hastened when the science of agriculture will rank with such tertiary sciences as geology, geography, and medicine as one of the great systems of knowledge of direct benefit to mankind.

We are, without doubt, in this country just on the edge of a great popular movement for the improvement of the conditions of rural life through the improvement of the rural schools. As one phase of this movement, there will come the broadening of the instruction in the principles of agriculture, so that in addition to college courses we shall have secondary courses in ordinary and special high schools and even some elementary instruction in the common schools. In establishing the lines and methods of secondary and elementary instruction in agriculture so that it may be useful and attractive to the masses of our rural youth, the leaders in agricultural science gathered in the Graduate School of Agriculture this summer will play an important part, and it is believed that they have gone out from this school with much inspiration to renewed efforts in this direction. For both the thorough establishment of the science of agriculture and the wide popularization of this science, the new school will, it is believed, be an efficient agency.

It is to be hoped, therefore, either that some other university will open its doors for a second session of the school another year, or that the Association of Agricultural Colleges and Experiment Stations will assume this burden, or that through the cooperation of the association with universities and the Department of Agriculture the Graduate School of Agriculture may become a permanent institution.

THE COLLEGES.

Several of the colleges have made real progress during the past year in strengthening and broadening their courses in agriculture. At the University of Illinois the college of agriculture now includes departments of agronomy, animal husbandry, dairy husbandry, horticulture, household science, and veterinary science, each offering in addition to the subjects required for graduation a number of elective subjects along special lines, such as farm machinery, drainage, soil bacteriology, the principles and practice of breeding, the standardizing of milk and cream, etc. The Michigan Agricultural College has added a five-year course in agriculture, which provides for advanced work in dairying, soil physics, and animal husbandry without raising the entrance requirements. The State College of Colorado has added another year to its agricultural course and offers special work relating to agriculture in arid regions. Minnesota has added a new line of work—instruction and laboratory work in cutting and curing meat. Kansas has raised dairying to the dignity of a department. California has established a dairy school in connection with the college of agriculture. Several of the institutions named and also a number of others have added to their staffs specialists in charge of agronomy, animal husbandry, and other branches of the general subject of agriculture, while not a few of them have added to the number of short or special courses in agriculture.

The committee on methods of teaching agriculture of the Association of American Agricultural Colleges and Experiment Stations, of which the Director of this Office is chairman, has presented a preliminary report on methods and facilities for teaching agronomy. Material is now in hand for a somewhat comprehensive illustrated report on this subject from a number of colleges which have differentiated agronomy from the general subject of agriculture.

College extension work is more and more demanding recognition as a legitimate function of the agricultural college. At Cornell University, Pennsylvania State College, and a number of other institutions this work is accomplished largely through the agency of reading courses and correspondence courses. Other colleges are publishing popular bulletins, press bulletins, and leaflets, while a constantly increasing number are reaching their constituents by means of periodicals edited and published by the college officials either with or without the cooperation of the students. Such periodicals are published at the agricultural colleges in Colorado, Kansas, Michigan, Minnesota, Nebraska, North Carolina, Ohio, and Washington.

Statistics of attendance at the land-grant colleges for the year 1901 show that over 42,000 students were enrolled. This was an increase of nearly 7 per cent over the attendance for the previous year. The total attendance upon four-year courses in agriculture (including dairying) increased more than 26 per cent. The number of students in special courses has fallen off relatively, indicating a growing recognition of the greater value of the full collegiate course in agriculture as compared with specialization along narrow lines in undergraduate work.

Last year attention was called to the fact that State legislatures had provided liberally for maintenance and new buildings at the agricultural colleges, and special appropriations aggregating $1,232,000 were mentioned. During the year many of the buildings thus provided for have been or are now being constructed, notably a central building

for the Wisconsin College of Agriculture to cost $150,000; a $60,000 agricultural building at Purdue University; a $50,000 agricultural hall at the Oregon State Agricultural College; a $30,000 agricultural building at the New Hampshire College of Agriculture and Mechanic Arts; new barns, a new science building, and an addition to the mechanical building, costing in the aggregate $50,000, at the North Dakota Agricultural College; a $40,000 building for the department of irrigation engineering and the experiment station of the Colorado Agricultural College; two $25,000 buildings—one for chemistry and one for veterinary science—at the College of Agriculture of the University of Minnesota; three buildings—for animal industry, dairying, and horticulture—at the Missouri Agricultural College; a large building containing offices, lecture rooms, and library, and a new barn at the Oklahoma Agricultural College; and a chemistry building at the Kansas Agricultural College.

Appropriations fully as liberal as these have been made for the current year in States where legislative sessions were held during the past winter. The general assembly of Iowa has given the Agricultural College at Ames a one-fifth mill tax to run for five years, which is expected to realize about $600,000. This money is to be used for the erection of buildings. An additional appropriation of $135,000 was made for the biennial period—$35,000 annually for general maintenance, $10,000 annually for the experiment station, $5,000 for live stock, $35,000 to begin the erection of the main central building to take the place of the building destroyed by fire, and $5,000 to begin the erection of a barn for the station to replace the one destroyed by fire. Both Iowa and South Dakota have made important additions to their herds of pure-bred cattle.

The Mississippi Agricultural College has the most liberal appropriation in its history, including provision for a new building for agriculture and horticulture, scientific departments, library, and museum, $40,000; infirmary building, $10,000; additional equipment for textile school, $13,000; additional equipment for mechanic arts department, $8,300; enlarging capacity of mechanic arts building, $5,000; farmers' institutes for 1902–1903, $6,000; and a branch experiment station at McNeill, $13,000 for the biennial period.

Maryland has $25,000 for a new dormitory building and $8,000 for the enlarging and repairing of old buildings. Massachusetts Agricultural College has $35,000 for a central lighting and heating plant and $35,000 for a boarding house. The Michigan Agricultural College is erecting a bacteriological laboratory and a stable which will cost about $23,600, and has drawn plans for a new engineering building, a central heating plant, and an addition to the armory and gymnasium. Florida is to have a new science building to cost about $45,000; Clemson College, South Carolina, a new dormitory; Texas, a veterinary and chemical laboratory; Utah has completed new barns costing $12,000, and in New York the law appropriating $35,000 for Cornell University extension work has been reenacted.

Louisiana University is also liberally provided for, though not entirely from State funds. Congress, by a recent act, has ceded to the university the tract of land embracing approximately 150 acres, together with the buildings, which it has occupied subject to the needs of the United States for military purposes. The tract was originally a military fort, and some years ago was turned over to the State for the use of the university until such time as it might be needed for purposes of defense. Mr. John Hill, a prominent sugar planter near

Baton Rouge, has given $32,000 to the university for the erection of a fireproof library building as a memorial to his son. The State legislature at its recent session appropriated $47,000 for the erection of a dormitory and a building for the mechanic arts department, and $8,500 for furnishing the library building mentioned above. The usual appropriation of $15,000 for the experiment stations was made, and the appropriation for the State geological survey, which is under the charge of the director of the stations, was increased to $2,500 a year for two years.

Pennsylvania State College is also fortunate in receiving several large gifts, as follows: By Andrew Carnegie, $100,000 for a library building; by Mr. and Mrs. Charles M. Schwab, $60,000 for an assembly hall, and by James Gilbert White, class of '82, $10,000 for a graduate fellowship and $10,000 additional for three undergraduate scholarships.

The Virginia Polytechnic Institute has added a new science building to its equipment which provides for the departments of general and analytical chemistry, biology, mineralogy and geology, and physics.

The number of large appropriations for agricultural buildings, in which provision will be made for instruction in the subdivisions of the science of agriculture, indicates quite clearly a growing tendency not only to recognize the importance of instruction in agriculture, but also to recognize agriculture as a science.

The financial and statistical reports of the colleges receiving appropriations under the act of August 30, 1890, which in accordance with the law are regularly forwarded to the Secretary of Agriculture, have, as hitherto, been deposited in this Office. On the basis of these reports and replies to special circulars of inquiry, this Office has published statistics relating to the agricultural colleges for the year ended June 30, 1901. Reports for the fiscal year ended June 30, 1902, have now been received.

SECONDARY AND ELEMENTARY SCHOOLS.

Institutions for secondary and elementary instruction in agriculture are becoming more numerous. Schools of this class already established have been continued, new schools are being established, and courses of instruction in agriculture, nature study, and gardening are being introduced into existing public and private schools. In California $50,000 has been appropriated by the State legislature for the establishment of the California Polytechnic School, which has been located on a tract of 280 acres at San Luis Obispo. For the present attention will be confined to instruction in agriculture. Another new agricultural school of high-school grade is the Winona Agricultural and Technical Institute at Winona Lake, Ind., which will be opened for students this fall. The Hartford (Conn.) School of Horticulture is a new institution which has this year given instruction and practical work in gardening to over 160 grammar-school children at Hartford. On an adjoining farm is the Watkinson Farm School, where 20 to 30 boys find a home and instruction in agriculture. At Lowthorpe, Groton, Mass., a School of Horticulture and Landscape Gardening for Women has been opened. The two county agricultural schools provided for by the Wisconsin legislature in 1901 have been organized and will be opened this fall. At Springfield, Mass., The Home Correspondence School has been organized, with the professor

of agriculture of the Massachusetts Agricultural College in charge of agricultural instruction. The Briarcliff School of Practical Agriculture and Horticulture has outgrown its present quarters and secured 415 acres of land near Poughkeepsie, to which it will be moved next year. Instruction in agriculture has been made the basis of the course of study at the Thompsons Island Farm School, Boston, and has been introduced into the George School, near Newtown, Pa. In the three State normal schools of Missouri, during the past year, instruction in agriculture was given to 369 young men and women who will go out into the State as teachers in the public schools. In this connection it is worthy of note that a number of normal schools in different parts of the country now require their students to devote a part of their time to nature study and garden work as a preparation for their work in public schools, and in Wisconsin every teachers' examination now includes a set of questions on agriculture.

The Minnesota movement for the introduction of agriculture into the rural schools has been placed in charge of the professor of agriculture of the university, who has prepared a 200-page bound bulletin outlining exercises to be used by the teachers in the rural schools. The subjects treated in this bulletin include agriculture, horticulture, cooking, sewing, housekeeping, laundering, agricultural chemistry, domestic animals, dairying, and other subjects.

The superintendent of Indian schools, Miss Estelle Reel, of the Department of the Interior, has outlined a course of study for Indian schools, with the approval of the Commissioner of Indian Affairs and the Commissioner of Education, in which the teaching of the theory and practice of agriculture is provided for in all the grades. The civil-service examination for teachers of agriculture for the Indian service has been changed so as to include tests of the candidates' knowledge of the science as well as the practice of agriculture.

Marked progress has been made in the movement for the consolidation of rural schools which has already resulted in improved conditions in the schools of Ohio, Massachusetts, Iowa, and other States. Along with this movement there is considerable agitation for the introduction of agriculture wherever the employment of additional teachers makes it possible to broaden the courses of study. An article on "Some problems of the rural common school" was prepared by the Director of this Office and published in the Yearbook of the Department for 1901. Among the drawbacks to the successful introduction of agriculture into these schools are lack of well-trained teachers and of suitable text-books. There is also a great deal of uncertainty about what should be included under the title "An elementary course in agriculture." To the study and solution of this problem this Department might well devote some attention.

Another closely allied movement at present manifest principally in the city schools is the school garden movement—the introduction of garden work with flowers and vegetables into the graded schools as a weekly or semiweekly exercise. Wherever work of this kind has been tried under proper supervision it has aroused considerable interest on the part of the students, has furnished excellent material for nature study work, and has correlated well with the other studies in the curriculum. This Department could promote the school garden movement by the distribution of flower and vegetable seeds and shrubs, and by the preparation and distribution of publications giving directions for the laying out and planting of such gardens, and for the care of the plants grown from the seeds sent out by the Department.

FARMERS' INSTITUTES.

In my last annual report I recommended that an appropriation of $5,000 be asked for to enable this Office to undertake the work connected with the promotion of the farmers' institute system in this country. The appropriation was to be used in employing an officer who would devote his time and energy to this work, visit institute workers and advise them regarding the ways in which the Department might help the institutes, study the problems of institute management at home and abroad, and seek to shape the Department's work for the institutes so that it might be most helpful to this enterprise. As the matter was finally fixed in the appropriation act, only about $2,000 of the income of this Office for the current fiscal year can be used for this purpose. This is entirely inadequate for the work planned, but will be used in gathering statistics of the institute movement and in employing, during a part of the year, an officer who will be retained as the farmers' institute specialist of this Office, if Congress shall provide sufficient means for continuing the work.

At the seventh annual meeting of the American Association of Farmers' Institute Workers, held in this city June 24–26, the plans of this Office for aiding the farmers' institute movement were explained to the members and their hearty approval of the scheme was expressed by the unanimous adoption of the following resolution:

Resolved, That the American Association of Farmers' Institute Workers cordially and most heartily approve the action that has been initiated by the Secretary of Agriculture in the matter of closer communication between the Department and the farmers' institutes, with the hope that an agent will be appointed as suggested in Dr. True's paper.

Farmers' institutes are now held in 44 States and Territories, including Hawaii. Nearly complete returns from 40 States and Territories show that in the areas reported about 2,300 institutes are held annually; that the funds expended by the different States and Territories in support of these institutes (not including expenses incurred by local authorities) amount to about $196,000 per annum, and that about 709,000 people attend the institutes. The number of students taking the agricultural course at the agricultural colleges in these same States and Territories during the year ended June 30, 1901, was 9,623, including those who are recorded as attending courses in household economy, dairying, and veterinary science.

The total number of persons reached by the farmers' institutes and the agricultural colleges (about 720,000) is, however, only a small percentage (7.2 per cent) of those actually engaged in agricultural pursuits (about 10,000,000). The publications of the experiment stations are sent to about 500,000 farmers. A great need of our educational system is, therefore, wider dissemination of the results of agricultural study and research among those now actually engaged in farming. In the nature of the case the various agricultural colleges and experiment stations can directly reach only a comparatively limited number of the younger men whose influence will be felt largely in the improvement of the agriculture of the future. The greatest good can not be accomplished, therefore, unless more is done to improve the agricultural practice of the present. No more effective means than the farmers' institutes has been found for the broad dissemination of reliable agricultural information in such a way as to make it available for the immediate use of the practical farmer.

To an institution of such wide extent and universal importance this

Department should be most intimately and helpfully related. In this direction a beginning has been made, but much more needs to be done.

The chief service which the Department has rendered has been through the distribution of its publications to institute workers, who have thus been enabled to keep in touch with the progress of agriculture as reflected in these publications. Occasionally some officer of the Department has spoken at the institutes, but there has been no regular plan for the oral dissemination of the information gathered by the Department. The Office of Experiment Stations has in recent years issued a few publications giving account of the work of institutes in this country and similar work abroad, and has published the proceedings of the American Association of Farmers' Institute Workers.

In a few of our States the farmers' institutes are quite thoroughly organized, have liberal financial support, and reach a large percentage of farmers, but in many States and in the Territories the movement is yet in a comparatively weak condition, and the organization and means for this work are inadequate. In 19 of the States and Territories no special appropriations for institutes are made, the funds for this work being taken from funds provided for the support of the agricultural colleges or the State boards of agriculture. In 23 States and Territories the appropriations range from nothing to $1,000 per annum; in 12, from $1,000 to $5,000; in 3, from $5,000 to $10,000; in 4, from $10,000 to $15,000, and in 3, above $15,000, While in most cases these figures do not represent the total expenditures for farmers' institutes, they indicate fairly well the extent to which the movement is organized in different sections. It is apparent that in more than half of the States and Territories much needs to be done in the way of starting and perfecting an organization for conducting farmers' institutes. If an interest in the work could be aroused among the farmers in these sections and the way to secure the institutes pointed out, it is fair to presume that funds for the more liberal support of the movement would be speedily forthcoming. This Department, through its Office of Experiment Stations, may assist in this work of organization in the same way that it has helped the experiment stations throughout the country. The visits of the officers of the Department to the stations in the different States and the conferences held at Washington and at the meetings of the Association of American Agricultural Colleges and Experiment Stations have, it is believed, done much to systematize the work of the stations and make them more efficient. In a similar way an institute specialist from this Office might visit the managers of the institutes and the institutes themselves in different States and Territories, and meet representative institute managers and workers at Washington or in conferences held in different parts of the country. Already there is a successfully conducted American Association of Farmers' Institute Workers, which may easily be developed so as to become a very important factor in the further development of the farmers' institute movement.

At the recent convention of this association delegates were present from 24 States. How to secure competent institute workers was a problem seriously troubling nearly all of the delegates, even those coming from the States where the institutes are most thoroughly organized and successfuly conducted. The demand is for institute workers having a wide range of knowledge regarding the science and practice of agriculture and particularly up-to-date information regarding the

progress that is being made throughout the world in studying problems in agriculture both at the experiment stations and on the farms. Such men are relatively scarce, except among the officers of our agricultural colleges and experiment stations whose other duties are in most cases so exacting that they can not be expected to devote much time to institute work. There is need of developing a class of institute workers who shall combine successful practical experience and scientific knowledge of agriculture with the ability to address large audiences of farmers in a way not only to hold their attention, but also to impart to them definite information and instruction. This involves the creation of a corps of institute workers who shall receive sufficient salaries to induce them to make specific preparation for their work and to enable them to keep the information in their addresses up to date by studies pursued from year to year. In the task of developing and training these men the Department can help by furnishing them with the Department publications and information through correspondence. This is already done to a considerable extent, but may be more efficiently and thoroughly done by having in the Department a regular agency for this work. The institute workers would undoubtedly appeal to the Department with much more freedom if they felt that their work was definitely recognized there, as is the case with the agricultural colleges and experiment stations. They should also be made to understand that they are very welcome to come to the Department, and by residence at Washington for a longer or shorter time have opportunities for acquiring information through personal contact with the officers of the Department, the use of its Library, etc.

This Department might also aid in this movement by sending out lecturers to address representative institutes in different States on the work of the Department. Thus far the Department has trusted very largely to its publications for the dissemination of the information which it gathers, and which has grown to be very large in extent and variety. It would hardly be practicable for the Department to be represented in a single year at any considerable number of institutes in any one State or Territory, but it is believed that more might be done to bring the work of the Department directly to the attention of the leaders in this enterprise through the attendance of Department officers at representative meetings, which might be held from time to time in the different States under such conditions as would bring together relatively large numbers of farmers. In this way the influence of the Department would be extended and its officers would have opportunities which they now lack for finding out what the farmers really desire to have the Department do for their benefit. An organization in the Department to promote this work would undoubtedly make it possible for the Department to do much more in this direction, even without any considerable funds especially devoted to the purpose.

In general, this Department should act through its Office of Experiment Stations as a sort of clearing house for the farmers' institute movement, as it has done in the case of the agricultural experiment stations; that is, it should become the center for the focalization and dissemination of information and influences which will serve to develop farmers' institutes, and make them a more efficient means for the education of our farmers and the improvement of our agriculture. I therefore recommend that an appropriation of $6,000 be asked for to enable this Office to aid the farmers' institutes during the fiscal year 1904.

ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

The fifteenth annual convention of this association was held at Washington, D. C., November 12–14, 1901. The Director of this Office was a delegate and was also reelected bibliographer of the association. A number of other officers of the Department attended the convention and took part in its proceedings. The stenographic report of the proceedings was prepared under the supervision of the Director, and has since been edited by him and Mr. W. H. Beal, of this Office, and the chairman of the executive committee of the association, and issued as Bulletin No. 115.

Reports were made by the committee on methods of teaching agriculture, indexing agricultural literature, and graduate study at Washington. The Director of this Office has performed a considerable amount of work during the past year as a member of these three committees.

A committee was appointed to prepare a collective college and experiment station exhibit at the St. Louis Exposition, and the Director of this Office was made a member of this committee.

The committee on cooperation between the stations and this Department made the following report, which was adopted:

Your committee on cooperation between the stations and the Department of Agriculture would respectfully submit the following report as supplementary to the report of one year ago:

A year of reflection and observation has strongly confirmed your committee in the belief that the principles for guidance in cooperation between the stations and the Department of Agriculture which were embodied in your committee's report one year ago and adopted by the association are substantially correct. Very satisfactory progress has been made during the year in systematizing cooperation. While it is perhaps unnecessary to add anything to the previous statement of principles, yet a little fuller explanation may not be inadvisable; and your committee would therefore add the following recommendations:

First. When cooperation is desired by the station, it is deemed advisable that the proposal for such cooperation be made to the Department by the director of the experiment station. Where, on the other hand, the Department desires cooperation of the station, it is deemed advisable that the proposal be made in the first instance to the director rather than to a member of his staff.

Second. While it is well understood that no financial obligations can be undertaken beyond the end of the fiscal year, yet it should be recognized that any arrangement for joint experimentation which requires some years to complete creates a moral obligation upon both parties to carry the work to a conclusion.

Third. When a line of investigation has been in progress in any State under the auspices of either institution, it is, as a rule, unwise for the other party to undertake independently the same line of investigation, at least until after full consultation upon the subject.

The following resolutions regarding a new building for this Department were adopted:

Whereas the United States Department of Agriculture has long since outgrown the single building originally provided for its special use; and

Whereas this Department has accomplished unmeasured good in the advancement of agriculture in these United States; and

Whereas this division of Government service has been appropriately recognized by advancing its chief officer to the high position of a member of the President's Cabinet: Therefore be it

Resolved by the Association of American Agricultural Colleges and Experiment Stations in convention assembled, That we urge upon Congress the necessity and wisdom of providing a building for the accommodation of the Department of Agriculture, which in magnitude shall be sufficient to amply accommodate for decades to come the still expanding divisions of departmental effort, and which shall properly represent in its architecture the enormous importance of agricul-

ture in this country, and which shall constitute a worthy member of the Government's collection of buildings in this the Capital City of the United States.

Resolved, That the secretary of this association be directed to forward a copy of these resolutions to the Hon. James Wilson, Secretary of Agriculture, and to the presiding officers of both the legislative branches of the Government.

Among the subjects of general interest discussed at this convention were plant breeding, experiments with grasses and forage plants, irrigation in humid regions, and range improvement and administration. A paper on agricultural libraries was read by the Librarian of this Department. The annual address of the president of the association, Dr. A. W. Harris, presented the development of the land-grant colleges as instrumentalities for technical education, and contained an argument for the support of higher education with public funds.

RELATIONS WITH FOREIGN INSTITUTIONS.

The work of preparing a card catalogue of foreign agricultural institutions for education and research has been continued, and an account of the organization, equipment, expenditures, and work of about 720 experiment stations has been published as Bulletin No. 112 of this Office. The work of revising this bulletin is now in hand, and quite a large amount of additional information has been obtained for this purpose.

One of the most important recent events from an agricultural point of view is the establishment of the department of agriculture and technical instruction for Ireland. This department was organized for the purpose of aiding, improving, and developing agriculture, fisheries, and other industries in Ireland in such a manner as to stimulate and strengthen the self-reliance of the people. The department is associated with four advisory and cooperating boards or committees, and has an endowment of over $800,000, besides funds for maintaining a number of institutions turned over to it. The distinctive agricultural features already inaugurated are along the lines of agricultural instruction, the improvement of live stock, and agricultural experiments and investigations. The plans for the improvement of live stock include the introduction of pure-bred stallions and bulls, which are loaned or sold on contract to farmers, and the distribution of awards for approved animals grown by the farmers. The building of cooperative creameries, the erection of plants for pasteurizing milk, and the promotion of other means for encouraging dairy husbandry are brought about by a system of loans. Cooperative experiments for the introduction of new products and industries and other enterprises of a practical nature are being developed.

Among other noteworthy events in Great Britain are the establishment of a private experiment station of the American type, known as the Aynsome Experiment Station, at Grange-over-Sands, Lancashire, England, by J. S. and T. M. Remington, and the holding of a nature study exhibition of international scope at Regents Park, London, at which this Department exhibited a collection of publications on nature study from the different agricultural colleges, experiment stations, and departments of agriculture in the United States.

In France an office of agricultural information has been established under the ministry of agriculture. It takes the place of the former bureau of agricultural statistics and food products, and will collect and publish statistical information in regard to agriculture, agricultural labor, products and conditions, imports, public sales, etc., in

France and foreign countries. It will also study and report on methods of packing, preserving, and shipping agricultural products, and will publish the results of scientific investigations in agriculture in France and foreign countries and the proceedings of agricultural societies, syndicates, and other similar bodies.

Agricultural instruction in the British West Indies is rapidly assuming definite form under the supervision of Dr. Morris, Imperial commissioner of agriculture for the West Indies. At present the system comprises lectures to teachers in charge of elementary schools, agricultural teaching in secondary schools and colleges, and itinerant instruction to planters. The Imperial department of agriculture has issued a text-book on nature study for the use of teachers and has recently begun the publication of a fortnightly review known as Agricultural News.

Among experiment stations recently established are the Seed Control Station for Forest Seeds in connection with the Royal Prussian Forestry Academy at Eberswalde; the Agricultural Experiment Station at Augustenberg, formed by the union of the chemical and botanical stations formerly located at Karlsruhe; a dairy station in connection with the Agricultural Institute at Gembloux, Belgium; an agricultural physiological experiment station in connection with the Technical High School at Prague, Austria, and an experimental farm established in the fall of 1900 at Grafton, New South Wales, for the purpose of introducing the dairy industry on the north coast. The department of agriculture of Victoria, Australia, is agitating the question of establishing experiment stations in place of the existing demonstration fields and farms, which, while adequate for the development of new agricultural industries in Victoria, are not broad enough in scope for a high grade of investigational work.

Work for the Civil Service Commission.

The Director of this Office has continued to act as the general representative of the Department in matters relating to examinations held by the Civil Service Commission for technical and scientific positions in the Department. The number of papers received from the Commission, recorded in this Office, and rated by examiners in the Department during the year was about 490, as compared with 260 last year. Besides the regular examinations, 37 special examinations were held during the year. The register for scientific aids has been continued and a considerable number of appointments have been made from it during the past year. The examination for "assistant" has been greatly simplified, and as combined with the examination for scientific aid has provided a regular method for the entrance of competent scientific aids into the classified service. Considerable attention was given to the formulating and discussion of plans for the registration of laborers. This resulted in an order issued by the President July 2, 1902, regulating the appointment of laborers in the Department and providing for a board of labor employment, which has been appointed by the Secretary and entered upon its duties. With the growth of the business of the Department and the consequent increase in the number of its employees, the work involved in the relations of this Office with the Civil Service Commission has grown to be considerable.

Publications of the Office.

During the year the Office issued 39 documents, aggregating 3,768 pages. These include 9 numbers of the Experiment Station Record, 16 technical bulletins, 2 reports, 6 Farmers' Bulletins, 2 circulars, and 4 articles for the Yearbook of the Department. There were also 57 articles, aggregating 1,257 pages, published as separates. Two other numbers of the Experiment Station Record and 6 bulletins, containing 1,116 pages, were prepared and submitted to the Division of Publications during the year. The plan has recently been followed of combining smaller articles on related subjects in larger reports and bulletins for limited circulation and employing separates to supply additional demands for the individual articles. This results in a saving of labor and expense and at the same time secures a more effective distribution of the publications. The lack of funds for printing during a portion of the year retarded the publication of a number of documents prepared in this Office during the period covered by this report.

The several reports annually made to Congress by this Office were the past year combined in one document, entitled the Annual Report of the Office of Experiment Stations. It was hoped that this would secure more prompt and economical publication of this material and do away with the necessity for the passage of several joint resolutions by Congress to provide for the printing of different documents as hitherto. In transmitting this report to Congress it was recommended that provision be made for printing it annually. No action was taken on this recommendation, and even the resolution for the printing of the report for last year failed to pass the House of Representatives. As it is quite important that the officers of the agricultural colleges and experiment stations be provided with copies of this report from year to year, I recommend that efforts be continued to secure the consent of Congress to a measure providing for its annual printing.

Experiment Station Record.

The Experiment Station Record, containing a comprehensive review of the literature of agricultural science, as well as editorials on matters of particular interest, special articles, and notes covering a wide range of subjects related to agriculture, has been published as heretofore under the general editorial management of Dr. E. W. Allen, assistant director of the Office. In Volume XIII, which has been completed, considerably more space has been devoted to editorials and notes than formerly. Increased attention has been paid to the items published under the latter head. These have included facts concerning the current work of the experiment stations and changes in their staffs, notices of new journals, brief summaries of the proceedings of various associations, comments on agricultural education and investigation in foreign countries, personal items, and many other subjects of special interest to readers of the Record. In order to enable the publication of more material in the space available, the abstracts have been printed wholly in brevier type, instead of in long primer and brevier as in earlier volumes. This method, while permitting the publication of much more material, has greatly increased the labor involved in the preparation of the Record. Notwithstanding the use of smaller type it is still difficult to find sufficient space for adequate abstracts of even the more important articles in the rapidly increas-

ing amount of agricultural literature reviewed. During the last three years the number of pages reviewed has more than doubled. (In Volume X 57,230 pages, and in Volume XIII, 115,427.) The abstract committee of the Association of Official Agricultural Chemists, which previously cooperated with this Office in the preparation of abstracts on methods of agricultural analysis, has been discontinued, and this work has been attended to by the editorial staff of the Office.

The thirteenth volume of the Record comprises 931 pages devoted to abstracts, 58 to editorials, 67 to special articles, and 56 to notes, which, with name and subject indexes, makes a volume of over 1,200 pages. It contains abstracts of 378 bulletins and 59 reports of experiment stations in the United States, 205 publications of the Department of Agriculture, and 1,555 reports of foreign investigations. The total number of abstracts is 2,800, and the total number of pages in the publications abstracted is 115,427. In addition, briefer reference is made to nearly 1,500 other articles which did not seem to call for extended notice. The total number of abstracts and titles together is 4,290, classified as follows: Chemistry, 326; botany, 182; fermentation and bacteriology, 47; zoology, 47; meteorology and climatology, 152; air, water, and soils, 127; fertilizers, 184; field crops, 475; horticulture, 486; forestry, 100; seeds and weeds, 82; diseases of plants, 291; entomology, 342; foods and nutrition, 252; animal production, 264; dairy farming and dairying, 264; veterinary science and practice, 385; technology, 24; agricultural engineering, 101; statistics and miscellaneous, 159.

This volume also contains special articles as follows: "Agricultural experiment stations of Hungary;" "The ash constituents of plants, their estimation and their importance to agricultural chemistry and agriculture," by B. Tollens, published in two parts; "New agricultural building at Purdue University;" and "The station for plant breeding at Svalöf, Sweden," by D. G. Fairchild. Condensed accounts of the proceedings of the eighteenth annual convention of the Association of Official Agricultural Chemists and of the fifteenth annual convention of the Association of American Agricultural Colleges and Experiment Stations are included. The following topics are discussed in the editorials: Investigations of poisonous plants; the Hungarian experiment station system; statistics of agricultural colleges and experiment stations for 1900; need for investigation in stock breeding; organization of the Bureau of Soils; the use of funds for lease of college land grant; new agricultural building; Prof. Max Maercker, deceased; a school of practical agriculture and horticulture; farm practice in agricultural education; a graduate school of agriculture; the new Bureau of Agriculture for the Philippine Islands; Sir Joseph Henry Gilbert, deceased; agricultural education in England under the county councils; William Le Roy Broun, deceased; new aspects of agricultural education; the department of agriculture for Ireland; a new experiment station in England; the agricultural experiment stations of the world; cooperative fertilizer experiments in Germany; "euphorimetry," or the art of measuring the fertility of the soil; agricultural-meteorological observations in Russia; the agricultural appropriation act, 1902–1903; J. Sterling Morton, third Secretary of Agriculture; cooperation in experimentation; progress of experiment stations abroad; meeting of farmers' institute workers at Washington; agricultural experiment stations for Victoria, Australia; permanent location of Porto Rico station; an enthusiastic view of American stations and colleges; biological

soil studies; a new departure in agricultural education; and the early literature of agriculture.

Pressure of matter and the limitations of space have made it necessary to condense more in the abstract part of the Record, and to confine the abstracts of even the most important articles to a concise statement of the scope and the principal results. In general, the length given to an abstract depends upon the extent and character of the article and its relation or application to science. The most frequent suggestion for improving the Record is that more details be given in the abstracts, and to those who do not have access to the foreign literature in the original or read it readily a fuller abstract would often be of service. The aim has been to give, in the 12 numbers of 100 pages each which are issued annually, as comprehensive a review as possible of the literature of agricultural science, so as to enable the agricultural investigator and instructor and others whose work requires a knowledge of the progress which is being made, to keep abreast of the times, and to look up the current literature on any phase of agricultural science, as occasion requires. There is continued evidence of the usefulness of the Record in its present form and of the wisdom of its publication as a public document. It fills a place which is not occupied, except in part, by any other periodical in the world, and its publication could not be profitably undertaken by any private publishers. Many calls come for it from institutions and specialists in foreign countries, only a part of which can be met. A large amount of agricultural literature in the shape of books, bulletins, periodicals, and excerpts is now received in exchange for the Record, which is of material assistance in following up the review.

The detailed subject indexes of the first 12 volumes of the Record and of Bulletin No. 2 of the Office, which contains a digest of experiment station reports for 1888, have been combined in a general index. This furnishes a complete index to all experiment station work in this country since the passage of the Hatch Act, and to a very large proportion of all other contemporaneous literature along lines related to agricultural science. The publication of this index will be of great convenience and value in connection with the work of this Office, and to the large number of experiment station workers and others making constant use of the Record. The index is nearly ready for the printer, and it is hoped that arrangements may be made for its early publication.

MISCELLANEOUS PUBLICATIONS.

The miscellaneous publications of the Office consist chiefly of (1) technical bulletins and reports, and (2) Farmers' Bulletins, including the series known as Experiment Station Work. The editorial work involved in the preparation of these publications for submission to the Division of Publications constitutes the business of the editorial division of this Office, of which Mr. W. H. Beal is chief.

TECHNICAL BULLETINS.

The Evolution of Reaping Machines, by Merritt Finley Miller (Bulletin No. 103, pp. 43, pls. 9, fig. 1), is a summarized history of the various stages in the development of reaping machines, showing the more important advances made in developing the perfected modern harvester.

Results of Investigations on the Rothamsted Soils, being the Lectures Delivered under the Provision of the Lawes Agricultural Trust,

by Bernard Dyer (Bulletin No. 106, pp. 189). These lectures summarize the results of all observations and experiments made on Rothamsted soils up to the time of the preparation of the lectures in 1901, including the results of the author's exhaustive studies on the phosphoric acid and potash contents of the soils.

Proceedings of the Sixth Annual Meeting of the American Association of Farmers' Institute Workers, held at Buffalo, N. Y., September 18 and 19, 1901, edited by A. C. True and D. J. Crosby, for the Office of Experiment Stations, and G. C. Creelman, for the association (Bulletin No. 110, pp. 55).

Organization Lists of the Agricultural Colleges and Experiment Stations in the United States, with a List of Agricultural Experiment Stations in Foreign Countries (Bulletin No. 111, pp. 130), contains the staff of the Office of Experiment Stations and a list of the officers of the Association of Agricultural Colleges and Experiment Stations, of the Association of Official Agricultural Chemists, of the Association of Economic Entomologists, of the Association of Veterinarians of Experiment Stations, and of the American Association of Farmers' Institute Workers; a list of agricultural colleges and experiment stations in the United States, with governing boards, courses of study, boards of instruction, station staffs, and a list of station publications received by the Office of Experiment Stations during 1901; a list of experiment stations in 67 foreign countries, with their locations and directors, and a list of their publications received by the Office of Experiment Stations during 1901. The bulletin contains a complete index of names.

Agricultural Experiment Stations in Foreign Countries, by A. C. True and D. J. Crosby (Bulletin No. 112, pp. 230). This bulletin summarizes the available information regarding personnel, origin, equipment, income, and lines of work of about 720 agricultural experiment stations and related institutions in some 46 foreign countries. The matter is arranged alphabetically by countries and cities.

Statistics of the Land-Grant Colleges and Agricultural Experiment Stations in the United States for the Year ended June 30, 1901 (Bulletin No. 114, pp. 39), shows the number of officers and students, endowment, equipment, and revenue of the colleges, and the number of officers, revenues, expenditures, lines of work, additions to equipment during the year, and number of publications of the stations.

Report of the Director of the Office of Experiment Stations for 1901, by A. C. True (Annual Reports, Department of Agriculture, pp. 175–233).

Annual Report of the Office of Experiment Stations for the Year ended June 30, 1901 (House Doc. No. 334, Fifty-seventh Congress, first session, pp. 482, pls. 41). This includes a report on the work and expenditures of the agricultural experiment stations in the United States, with detailed reports of the special agents in charge of the stations in Alaska, Hawaii, and Porto Rico, and accounts of the nutrition and irrigation investigations, thus combining in one document reports which heretofore have been published separately.

Some Problems of the Rural Common Schools, by A. C. True (Yearbook of the Department of Agriculture, 1901, pp. 133–154, pl. 1, figs. 4), discusses the present needs of these schools and suggests various means of improvement, including lengthening the school term, employing teachers in sympathy with farm life and prepared to introduce the study of agricultural subjects, consolidation of small, poorly equipped schools in larger and better equipped schools, and development of the school as an intellectual center of the community.

Agricultural Investigations in the Island Possessions of the United States, by Walter H. Evans (Yearbook of the Department of Agriculture, 1901, pp. 503–526), shows briefly the general condition of agriculture, the present status of the principal agricultural industries, and traces the attempts that have been made to improve the agriculture of Porto Rico, Hawaii, and the Philippines.

The publications on the subjects of nutrition and irrigation issued by the Office during the year are noted on pages 286 and 300, respectively.

FARMERS' BULLETINS.

Irrigation in Field and Garden, by E. J. Wickson (Farmers' Bulletin No. 138, pp. 40, figs. 18). See p. 301.

How to Build Small Irrigation Ditches, by C. T. Johnston and J. D. Stannard (Farmers' Bulletin No. 158, pp. 28, figs. 9). See p. 301.

Principles of Nutrition and Nutritive Value of Foods, by W. O. Atwater (Farmers' Bulletin No. 142, pp. 48, charts 2). See p. 287.

The Feeding of Farm Animals (revised edition), by E. W. Allen (Farmers' Bulletin No. 22, pp. 40). This useful summary of the principles on which the successful feeding of farm animals is based was thoroughly revised and brought up to date.

Experiment-Station Work.

Three numbers (XVIII–XX, Farmers' Bulletins Nos. 133, 144, 149) and a title-page, table of contents, glossary, and index to Volume I of this series of bulletins, embodying in popular form some of the more important practical results of the work of the experiment stations in this and other countries, were issued during the year.

CARD INDEX.

Copy for 1,200 cards of the index of experiment-station literature has been prepared in the Office and forwarded to the Division of Publications during the year. This index is now kept as closely up to date as the conditions under which it is published will permit. The number of index cards distributed has reached 22,500. The receipts from sales of this index during the year were $145.50. Owing to requests for portions of the index on special topics, it has been decided to break a limited number of sets to satisfy this demand.

BIBLIOGRAPHICAL WORK.

The Office has cooperated with the Library of the Department in the preparation of a list of works on irrigation, land drainage, and closely allied subjects. Bibliographies of the botany of maize and nitrogen assimilation, and the sources of data relating to ash analyses of American farm products have been added to. Considerable additions have also been made to the bibliography of nutrition of man and animals, especially of bread and closely allied topics.

The collection and cataloguing of publications of the agricultural colleges and experiment stations in this and other countries have been continued during the past year as heretofore, and a list of foreign experiment stations has been prepared and published as in previous years. In addition a report (Bulletin No. 112), giving brief accounts of all experiment stations and related institutions of which data were available, was published during the year. (See page 266.) A large

number of foreign publications of all kinds have been received as exchanges. Many duplicates of station and other publications were received, a considerable number of which were distributed to college and station libraries and officers. The number of requests from college and station officers for the loan of books from the Department Library increases from year to year. The service thus rendered by the Department is greatly appreciated by these officers, many of whom do not have access to large libraries, and it is hoped that hereafter such privileges may be further extended.

Sets of Department and experiment station publications were furnished to the Alaska, Hawaii, and Porto Rico stations. In addition to the large number of Department and experiment station publications reviewed by the editorial staff of the Experiment Station Record, 1,028 new books on subjects relating to agricultural science and practice and several thousand numbers of periodicals from all parts of the world have been received and examined.

Experiment Stations in Alaska.

Agricultural experiment stations were maintained during the fiscal year 1902 at Sitka, Kenai, and Rampart. The experimental work has included the growing of cereals and vegetables, methods of reclamation, drainage, and fertilization of land, and the curing and ensiling of forage crops. In all these lines successful results were obtained, and much information which will be of use to persons attempting agriculture in Alaska was acquired. The survey of different portions of Alaska with reference to their agricultural possibilities was continued. The special agent in charge made a journey through a large portion of the Yukon River Valley. A reconnoissance of the Copper River region and portions of the Fortymile country and the Tanana River Valley was made during September, 1901, by Mr. Isaac Jones, who had been the assistant in charge of the station work at Rampart. Mr. Jones estimated that in the region covered by his journey there was some 2,000,000 acres of land suitable for farming and pasture. Grass grew abundantly and luxuriantly in large regions.

The distribution of seed of hardy varieties of vegetables, cereals, and grasses has been continued and extended, seed for use the present season having been sent to some 750 addresses. Many reports of trials of seed previously sent have been received, and in this way much useful information has been secured. It is evident that the efforts made by the Department to aid the residents of Alaska in their agricultural work by distributing improved varieties of seeds have produced beneficial results. Not only has this been of advantage to the white population, but the natives also are learning to cultivate gardens, and it is reliably reported that there is a large increase in the number of natives who attempt to cultivate small patches of ground.

The supervision of the voluntary observers of the Weather Bureau in Alaska has, by arrangement of the chief of that Bureau, been continued as in former years. This entails considerable correspondence, but gives valuable data in return. There are now 18 meteorological stations in Alaska supplied with instruments by the Weather Bureau which report monthly to the experiment station at Sitka.

A detailed report of the operations of the Alaska experiment stations during 1901 was prepared by the special agent in charge and published as a part of the annual report of this Office (House Doc. No. 334, Fifty-seventh Congress, first session). A bulletin, giving directions for the preparation of the soil and the planting of a num-

ber of crops adapted to Alaska conditions, was prepared and issued as Bulletin No. 1, of the Alaska experiment stations.

The station staff as now constituted consists of C. C. Georgeson, special agent in charge; F. E. Rader, assistant at Sitka; H. P. Nielsen, in charge of the station at Kenai; and J. W. Neal, who was appointed to make investigations in the Copper River country preliminary to the establishment of a station in that region.

The equipment of the station in Alaska has been increased in several ways. At Sitka a barn 50 by 25 feet and two stories high has been constructed. This has under one roof a silo, stalls for four head of cattle, seed and implement rooms, and rooms for the storage of crops. A cottage for the farm foreman and a small blacksmith shop have been built. The small station building at Kenai has been completed and furnished, and a telephone line nearly a mile long has been constructed at Sitka between the headquarters building and the farm.

PLANS FOR THE FISCAL YEAR 1903.

In addition to the work previously undertaken, preparations will be made for experimental work in the Copper River region. At Sitka a beginning will be made of establishing a nursery of hardy fruits. It is hoped to construct a small propagating house and procure nursery stock for propagation this fall. Only a limited amount of work in this line can be done until a horticulturist is added to the station staff. It is also planned to secure a small flock of Angora goats with a view to ascertaining whether these animals can be successfully reared in the coast region of southern Alaska. The plants naturally growing in this region will furnish abundant forage for goats. At the Kenai station it is proposed to continue the clearing of land and the growing of experimental crops as heretofore. Owing to the fact that the assistant at Rampart declined to continue longer in the service of the station the experimental work there the present season has been quite restricted. Mr. J. W. Duncan, the local agent of the Northern Commercial Company, has undertaken to care for the station property there and to grow and harvest some crops. He is also keeping a record of the soil temperatures at that place. At Wood Island the Rev. Curtis P. Coe, in charge of the Baptist Orphanage, has agreed to conduct certain experiments with grain and vegetables at a very moderate compensation. He has already begun this work, and will report results in the fall.

It is hoped to complete the headquarters building at Sitka during the present year. The cost of this work will be about $2,000. As soon as possible a small herd of cattle should be placed at the Kenai station and experimental work in animal husbandry begun. This would involve the building of a barn there and the employment of additional laborers. The station at Sitka should have an equipment of chemical apparatus sufficient for simple chemical work.

As long as the income of the stations is on the present basis it will not be possible to do more than maintain the stations at Sitka and Kenai and do a very limited amount of work at one or two places in the interior. To fully equip and creditably maintain a station either at Rampart or in the Copper River region will require the annual expenditure of from $5,000 to $7,500. Unless this amount is provided in addition to the present appropriation for the Alaska work, it will be necessary to confine our operations in the interior for the present largely to such work as can be done in cooperation with the residents of that region.

Hawaii Experiment Station.

For the fiscal year ended June 30, 1902, Congress authorized the Secretary of Agriculture to expend $12,000 in the establishment and maintenance of the agricultural experiment station in the Hawaiian Islands. As described in my previous report, preliminary steps had already been taken to begin work along this line and some of the clearing and building had begun. The site donated by the Territorial authorities for the use of the station is an uneven strip of land almost 3 miles long and in some places only a few hundred feet wide. It is situated on the mountain slope near the city of Honolulu, and parts of it are so steep that cultivation in the ordinary sense is almost impossible. Portions of this tract have been cleared and prepared for cultivation. The lower part of the tract was covered with a dense growth of shrubs and the upper part with timber. The only part of the station grounds adapted to cultivation without irrigation was this wooded portion, which by means of its elevation receives a much greater rainfall than the lower-lying lands. This forest land had been planted to eucalypts some years previous, but it was thought advisable to sacrifice a part of the trees to dry-land farming with the idea that most of it would again be restored to trees, including more valuable species than those which hitherto occupied the land. Thirteen and one-half acres were cleared and a considerable part planted to fruit and other valuable trees. About 35 acres of the lower land was cleared of shrubs and part of it prepared for cultivation, the intention being to utilize this area for trial plats, gardens, etc. When planting was begun upon the upper part of the station grounds the soil was found to be decidedly acid, and to correct this fault lime was applied at the rate of a ton per acre. An unlimed plat was retained as a check plat to observe the effect of the lime dressing. Fruit trees and vegetables that did not grow well before the soil was treated flourished wherever lime was added.

The buildings begun the previous year were completed, and now the station possesses a residence for the special agent in charge, an office and laboratory, stable, cottages for laborers, tanks, etc. A small two-room cottage was built on the upper part of the station grounds for the caretaker there, and a 3,000-gallon tank was erected at the same place, in which is caught and stored the water collected from the roof of the house. The exceedingly heavy rains in August caused the settling of one of the large tanks, and considerable effort was required to right it. The foundation for the tank had been placed well in the subsoil, but the long-continued rains caused it to soften, and the tank settled several inches on one side, throwing the pump out of order.

Experiments have been begun with potatoes and taro to overcome the very destructive diseases which seem to threaten the extinction of these crops. Taro forms the principal food of the Hawaiians, and the ravages of the blight have so curtailed the supply that there has been actual suffering in some places because of the shortage. At present the experiments are being confined to the low-land taro, and an effort is being made to find some remedy for the disease that attacks the root. Dry-land taro does not appear to be as susceptible to disease, but it will be studied also. It was found in many cases that immature and diseased cuttings were used for planting. The low-land form of taro requires extensive irrigation, and in practice the land is kept flooded for a considerable time. Wherever the water was allowed to

become stagnant it was found that the root rot was most prevalent. By the use of fertilizers it was found possible to actively stimulate the growth of the plant and make it less liable to disease. Wherever a liberal application of lime was made there was no disease, and with care in the management of the water, selection of cuttings, rotation of crops, use of lime and fertilizers it was found possible to not only reduce the disease, but to considerably increase the production of the crop.

The experiments with potatoes were conducted upon the island of Maui in cooperation with one of the residents of that island. This island formerly produced the most of the potatoes grown in the archipelago. A disease locally known as black rot has for ten or more years been seriously depreciating the crop. This, as has been determined by the station authorities, is due to a soil fungus, and experiments are being undertaken to combat it. In the field investigations 45 varieties of potatoes were grown under similar conditions, and marked differences were noted in the susceptibility of the varieties to disease. This work is to be followed up in the hope that some sorts may be found which are nearly or quite resistant to disease.

Investigations were begun on the diseases of poultry, and a bulletin was issued in which suggestions were given for the care of fowls and treatment of the diseases to which they are especially subject, and as a result of which poultry and eggs are excessively expensive in the Hawaiian markets.

Considerable interest has been recently aroused in the production of fiber plants, and the farm manager of the station was detailed to make a study of the subject, and material has been collected for a bulletin on the cultivation of sisal and its preparation for market.

Attention has been given to a number of minor crops that were believed worthy of investigation and development. A large number of seeds of rubber trees from Nicaragua were obtained and a quantity of acorns of the cork oak were secured from France. Most of these were intended for station planting, but a considerable quantity was distributed throughout the islands under conditions that were considered favorable to the station and to the recipients alike. Experiments are in progress on the improvement of the mangoes. A method of grafting that has proved successful in Florida will be tried, and it is hoped in this way to disseminate some of the more valuable varieties of that excellent fruit. The possibilities of castor-bean cultivation have been looked into and a very successful castor-bean plantation of more than a hundred acres is reported upon one of the islands. Further investigations will be given this subject. A considerable number of inquiries were received concerning the growing and marketing of peppers. Information on this subject was secured and furnished to the public through the medium of the local press. The growing of pineapples for canning purposes is being developed, and the advice of the station staff on this as well as many other topics have been eagerly sought and freely given.

Visits have been made by various members of the station staff to the other islands of the group, and an attempt has been made to get in touch with all the different agricultural communities. A special visit was made to the island of Hawaii, which in some respects contains the most diversified agriculture to be found on any of the islands of the group.

During a portion of the year the agent in charge made an investigation regarding the use of pumps for irrigation purposes in the

Hawaiian Islands. These islands are almost wholly without large rivers or natural surface reservoirs, and the rapid slope from the mountains to the sea makes the construction of artificial reservoirs impracticable except in a few favored localities. The rainfall of different parts of the islands depends upon the elevation of the land and its relative position, so that nearly every island has a distinct wet and dry area. On the wet side of the islands cane and other crops are grown to a considerable extent, but the most productive sugar-cane areas are on the so-called dry sides. This greater production is due to the greater fertility of the soils and to the utilization of the extensive stores of underground water through the medium of pumps. The pumping of water for irrigation purposes has in all probability reached its highest development in the Hawaiian Islands, and immense irrigation systems have been constructed and maintained, the water for which is pumped from considerable depths. A study was made of a number of these irrigation plants and a detailed report was made to the chief of the irrigation investigations of this Office giving the cost of construction, maintenance, capacity, height of lift, acreage irrigated, etc.

The first farmers' institute ever held in the islands was held at the Wahiawa colony, on Oahu, January 25, 1902, under the auspices of the officers of the experiment station. The attendance at this meeting was small, but a beginning was made, and since that time a number of similar institutes have been held in other parts of the islands with constantly increasing interest and attendance. A regular organization has been effected and a successful start has been made in the education of the Hawaiian farmers through the medium of the farmers' institutes.

A bulletin entitled "Chickens and their Diseases in Hawaii," by T. F. Sedgwick, was issued as Bulletin No. 1 of the station during the year. A bulletin on taro culture, with special reference to the rot affecting this plant, has been prepared. Other bulletins are in course of preparation.

A card catalogue mailing list was begun during the year and more than 500 names have already been listed for publications.

The present organization of the station consists of the special agent in charge, Jared G. Smith, who has general oversight of all matters relating to the station and who acts as special disbursing agent; T. F. Sedgwick, agriculturist; D. L. Van Dine, entomologist, who is making a study of the injurious insects of the islands, especially of the Japanese beetle, cutworms, cane borers, etc.; and F. E. Conter, who acts as farm manager and who has given considerable attention to the subject of fiber plants. Laborers are hired as required.

The station was seriously embarrassed during the year by a shortage of funds. Owing to the heavy drain on the income of the station for permanent improvements and equipment, it was found impossible to complete or in some cases to continue lines of investigation which were believed to be of great importance. Work was practically at a standstill for several weeks. The appropriation from the Federal Treasury was not sufficient to carry through the work as planned, and a bill providing for the appropriation of $5,000 by the Territorial legislature failed of passage.

There is a wide field for investigations in tropical or rather insular agriculture in this Territory. The problems there are very different from those on the mainland because of the extreme localization. There are scarcely two places on any of the islands which are identi-

cal in soil, temperature, rainfall, and other natural conditions. Everything depends on elevation and location in reference to the prevailing winds, that is, the northeast trade winds. There are a number of similar regions, but no two are alike. The land is not of synchronous formation, but is progressive from the northwest to the southeast. On every island consisting of more than one volcanic center that portion toward the west is the more ancient. On account of these differences individual investigations on such subjects as the testing of varieties and the introduction of new crops can have but local value.

The presence of enormous numbers of destructive insects is one of the chief obstacles to agriculture in Hawaii. The land areas are small and the uniformity of seasonal temperatures presents no check to the development of insects which may have been introduced from continental regions. As a result the insects speedily lose their distinctive habits. Many of the introduced species no longer have a definite life period, but breed at all seasons and are practically in continuous existence throughout the year, swarm following swarm, with no intervening period when the land is free from their ravages.

There are a number of serious fungous diseases of plants which require investigation, both because of the local losses caused by them and on account of the possibility of their being carried to other parts of the islands. The work on the taro rot and the Fusarium disease of the potato will need to be continued for several years.

There are many problems of both scientific and practical interest which require the services of a chemist. Soil and water analyses, the study of the rôle of mineral nutrients in plants and soils, the composition of Hawaiian foods and feeding material, all should be given attention. Investigations should be made as the occasion requires of other agricultural products which may lead to the establishment of local industries such as fiber plants, tans, dyestuffs, rubber, vanilla, coffee, tobacco, silk, fruits, and vegetables.

For the coming year it is intended to build a three or four room cottage on the lower portion of the station for the use of the entomologist and farm superintendent. The land inside the pasture fence is in fine condition, clear and free from weeds, and it is intended to plant about a quarter of an acre to Sumatra tobacco, testing the effect of shade on the quality of the product. A portion of the area already cleared on this part of the station will be devoted to plat experiments. At a somewhat higher elevation it is intended to plant alfalfa, sainfoin, and other leguminous crops for forage, and a few rows of sisal hemp will be planted. The station is now growing about a half acre of Manioc or cassava, four varieties of cotton, hemp, sorghum, and about a thousand grape cuttings representing 60 varieties in nursery rows. These should be set out in a permanent plantation later in the year. A greenhouse covered with cheese cloth is contemplated, in which an attempt will be made to grow strawberries and table grapes. Strawberries of good flavor but very small size are grown to a limited extent. This fruit is highly prized, and it is very desirable that some of the improved and better shipping varieties should be introduced.

It is planned to fence a considerably greater area during the coming year, to enlarge the poultry houses, and build an addition to the stable. At the higher elevation of the station, where there are now about 200 fruit trees, 500 pineapples, and a small vegetable garden, it is intended to continue these plantings and to undertake the

cultivation of some garden vegetables, such as cauliflower, celery, peas, and tomatoes.

The agriculturist will continue his potato experiments on Maui and his field trials with taro at Kalihi. The farm manager will continue investigations and write a report on the sisal hemp. The entomologist will investigate the melon fly, poka worm, Japanese beetle, and cane borer. The special agent in charge of the station will visit as many districts as possible on all of the islands to get in touch with the people and their needs, and the farmers' institute work will be continued.

Arrangements have been partially made for cooperative work with the Bureaus of this Department in the study of soils, tobacco, fibers, insect pests, and the introduction of new and improved varieties of plants. There is an urgent demand for experiments with coffee, but as yet it has been impossible to begin investigations in this line on account of the limited resources of the station.

Considering the numerous agricultural problems requiring investigation in the Territory of Hawaii, the experiment station there should, in my judgment, receive from the National Treasury as large an annual stipend as is granted to the stations organized under the act of Congress of 1887 (Hatch Act), namely, $15,000. If this is granted, it will be possible to add a chemist to the station force, to increase the apparatus and other equipment, and to provide for the printing and distribution of station publications.

Porto Rico Experiment Station.

The second appropriation for agricultural investigations in Porto Rico made for the fiscal year ended June 30, 1902, was $12,000, and authorized the Secretary of Agriculture to "establish and maintain an agricultural experiment station in Porto Rico, including the erection of buildings, printing (in Porto Rico), illustration and distribution of reports and bulletins, and all other expenses essential to the maintenance of said station." As the amount thus appropriated was not sufficient to provide for the purchase of land for the permanent location of the station, the work during the past year has been largely of a temporary nature. In October, 1901, 30 acres of land near San Juan and a building for office, laboratory, and living quarters were leased for a period of one year. A temporary barn was constructed for the shelter of animals and implements. A limited amount of machinery, in the form of plows, cultivators, and small implements, were either purchased or donated by different agricultural implement houses in the States. The necessary office supplies and fixtures were secured, and experimental work was at once taken up. A portion of the land was cleared of weeds and some brush, the drainage system was improved, and the land was put in fairly good condition for crops. About 100 garden and field crops were planted, mostly in small plats. Many of these were planted at different dates in order to ascertain the best time for planting. Many were repeatedly planted, because they were completely destroyed by the ravages of the changa or other insects. With a considerable number the effects of different kinds of commercial fertilizers were tried, usually with quite marked results. The most important thing that these experiments brought out was the very poor character of the soil on which these crops were planted, for almost none of them did well except where they were given some form of commercial fertilizer or barnyard manure. The season was

abnormal. November, December, and January were unusually wet, the total rainfall for the three months being 23.89 inches. During these three months there were only seventeen days on which no rain fell. At the close of January dry weather set in, and during the month of February the total rainfall was less than one-half inch, while for March it was only 2.19 inches. This very dry spell with strong trade winds from the east lasted until the middle of April, when rains set in again, and during May and June the total rainfall was 21.53 inches.

Insects and plant diseases, together with bad climatic conditions, and the impoverished soil, have undoubtedly been responsible in a great measure for the lack of success in bringing various classes of vegetables and field crops to maturity. Enough has been done, however, to show that certain of the vegetables which are common throughout most of the States are very difficult to grow successfully here, while others may be grown quite successfully if given the proper soil conditions and the proper methods of cultivation. Of the field crops, corn and kafir corn will grow very well and mature an abundance of seed. Oats produce a good growth of straw, but fail to mature grain. Rye and barley are practically failures. Several varieties of clover, field peas, and cowpeas did poorly, but the indications are that peas, cowpeas, and alfalfa would grow here under favorable conditions. Radishes, lettuce, beets, turnips, onions, carrots, parsley, watermelons, squashes, peas, beans, and spinach have grown fairly well when the rainfall has not been excessive, and the plants have been fertilized. Tomatoes and potatoes have been a failure, although tried several times, because of a bacterial disease which has completely destroyed the vines, before fruit or tubers could mature. Sweet corn has been tried perhaps ten or more times with absolute failure even when given fertilizers. Cucumbers and cantaloupes, which are so common in the States, have also proven failures, largely because of the inability of the small plants to withstand the attacks of insects and diseases.

A considerable amount of coffee seed was collected from the best formed and sturdiest trees from various plantations in the interior, and was planted in seed beds prepared especially for the purpose during January. The seed beds were protected with sheds to keep off the excessive rainfall as well as the greater part of the direct sunlight. The seed came up well, and upward of 30,000 fine coffee plants have been secured. These have now been transferred to the nursery beds, similar in every way to the seed beds, except that the plants are here given more room in which to develop. Fertilizers in different amounts and kinds have been applied to nearly all of the nursery beds, in order to give rapid growth to the plants, and to ascertain what kind and in what amount it is best to apply fertilizers for this purpose. A portion of these coffee trees will be used for planting experimental plats, while others will be distributed to representative planters in various parts of the island, to be planted and cared for according to the instructions which will be issued by the station. Preliminary preparations have been made for the improvement of an old coffee grove, but the actual work has not yet been commenced.

The station entomologist and botanist has done a large amount of work with various insects and plant diseases, and has commenced a collection of the flora of the island, giving special attention to economic plants. He now has approximately 275 species in the herbarium, two-thirds of which are in duplicate and of about one-third of which he has three or four specimens, which can be used for

exchange if so desired. He has also begun a collection of economic insects. Of the insects detrimental to agriculture in the island, the mole cricket, known as the changa, ranks first, and it has been made a subject of special study. Many experiments have been tried to prevent its ravages upon nearly all classes of crops. All available material in reference to its introduction into the island and its habits have been secured from planters and from such reports as have given meager information along this line. Sufficient material has already been brought together to make a bulletin upon the subject, which will be published in both Spanish and English for distribution in Porto Rico. Considerable attention has also been given to the combating of other insects by means of various forms of insecticides. The bacterial diseases affecting the tomatoes and a disease of similar nature which has caused failure in potatoes has also been treated with Bordeaux mixture, but without result.

The experiment station, in cooperation with the Bureau of Soils of this Department, has completed the field work of a soil survey embracing about 350 square miles in the western half of the island. This survey includes a strip 10 miles wide extending along the line of the military road from Arecibo to Ponce. It extends directly across the island, from the north shore to the south shore, and therefore crosses all of the geological formations, which, for the most part, extend east and west across the island. The manuscripts and map resulting from this work are now ready for the printer and will be published as a part of the field operations of the Bureau of Soils for the present fiscal year. As soon as the Department has issued this publication it would be well for the experiment station to have the report translated into Spanish and to secure an additional supply of maps to accompany it for distribution throughout the island.

The station staff as organized during the year consists of Frank D. Gardner, special agent in charge; O. W. Barrett, entomologist and botanist; P. A. English, farm foreman, and C. R. Newton, clerk and stenographer.

A bill asking the insular legislature to appropriate sufficient funds for the purchase of a suitable tract of land for the permanent use of the experiment station was introduced in the executive council in February, 1902. It passed both the upper and lower houses, with practically no opposition, and an appropriation of $15,000 was made immediately available for this purpose. Bids were advertised for toward the close of March and were closed on the 12th of May. Dr. W. H. Evans, of this Office, was sent to Porto Rico to aid in the selection of land for the station. The result of these negotiations was the purchase of approximately 230 acres of land adjacent to the city of Mayaguez. The land is varied in character and well located with reference to the city. It gives promise of making a very desirable site on which to carry out the objects of the experiment station. The buildings consist of a large dwelling house, which will be adequate for the accommodation of the station staff; an old sugar house, which has been transformed into offices and laboratory quarters; stables and other outbuildings, including a brick kiln and the usual sheds, which will serve for implement sheds. Possession of this property was not secured until a few days before the close of the fiscal year, but these few days were well improved and much work was done in putting buildings into repair and cleaning up roadways, fences, and ditches. All things considered, the work of the year may be considered quite successful, and much has been accomplished with the limited funds at our command.

PLANS FOR THE FISCAL YEAR 1903.

The buildings already on the station land, when painted and repaired, will meet the demands of the station in this direction for the present. As the funds of the station will not permit of the use of all the land for experimental purposes, it is proposed to put a considerable portion of this tract into grass or other crops which will yield some financial return through the maintenance of live stock or in other ways.

The work for this year will include further tests of both field and garden crops. It seems advisable to test pretty thoroughly the various kinds of leguminous crops which give promise of being useful in building up the worn-out soils of the island. Among these crops, alfalfa, velvet beans, soy beans, and perhaps a few others should be tried. Alfalfa should be tried for the purpose of furnishing forage, and also as a crop in connection with coffee planting, where it is attempted without shade. Some deep-rooted crop will be needed on the steep hillsides in order to keep the soil from washing away. In addition to the two principal grasses of the island, namely, malojilla and guinea, which are now practically the only ones used for forage and pasture, others should be tried, especially those that give promise of furnishing good permanent pasture on the mountain lands. Corn, rice, beans, and perhaps a few root crops should be given a permanent place among the field crops. The number of vegetables will be somewhat reduced and confined to those that give promise of the best results.

It is proposed to at once begin the work of planting a nursery and also orchards of all the principal tropical fruits that are being grown on the island, as well as promising varieties from other countries. Work should be commenced at once in the improvement of these fruits by grafting and selection.

Coffee experiments have been well begun, and it is proposed to extend them by securing control of about 35 acres of the estate known as "Carmelita," situated about 10 miles directly north of the city of Ponce. The managers of this large estate have indicated their willingness to cooperate with the station in this enterprise. To begin with, about 10 acres of an old grove is to be divided into as many different parcels, each one to be treated in a different way. Methods of pruning, cultivating, shading, and application of fertilizers will be the principal features of this experiment. In addition to this, a considerable number of the new coffee plants from our present nursery beds will be transferred to the field, some with and some without shade, as soon as they are large enough for the purpose. With these plants also different methods of pruning, cultivation, etc., will be tried. It is also proposed to assemble, as rapidly as possible, the principal varieties of coffee known to the world. This will in time furnish the means for cross breeding and for grafting, both of which will be important factors in coffee improvement.

Bulletins describing the objects and aims of the experiment station and giving the results of the investigations already made on the changa are being prepared and will be issued at an early day. It is hoped that at least two other bulletins can be published during the current fiscal year. There will also be continued effort made to bring the station into close touch with the agricultural people of the island through the visits of the station officers to different localities, addresses at farmers' meetings, correspondence, etc.

NEEDS OF THE STATION.

It is important that the Porto Rico station should undertake experiments with live stock, but it will not be possible to do much in this direction unless the resources of the station are increased. Additional funds will be required for the employment of a competent live-stock expert, the purchase of animals, and the general expenses of feeding experiments. In order to effectively conduct experiments with fruits a horticulturist should be added to the station staff.

Now that the Porto Rico station is permanently located, it should, in my judgment, receive the same financial support from the National Treasury as is given to the stations organized under the act of Congress of March 2, 1887. Considering the large population to be maintained by agriculture in Porto Rico, every effort should be made to develop the agricultural resources of the island. The station will be called upon to aid in the solution of a great variety of problems. The range and effectiveness of its work will necessarily be limited by the funds at its command. When the nation does as much for the Porto Rico station as for stations in the other States and Territories, there will still be need for additional financial assistance from the insular government. The cordial support which has been given the station by the government and the substantial grant of money voted by the insular legislature for the purchase of land for the station have given evidence that the people and government of Porto Rico appreciate the importance of this enterprise and are willing to supplement the efforts of the National Government in this direction. As the work of the station develops, additional buildings and equipment will be needed, and it is confidently expected that these requirements will be met by the local legislature.

NUTRITION INVESTIGATIONS.

The investigations on the food and nutrition of man, carried on in different parts of the country, have been continued during the past year, with Prof. W. O. Atwater as special agent in charge. The headquarters for these investigations have remained at Middletown, Conn., where the work is carried on in cooperation with Wesleyan University and the Storrs Experiment Station. Dr. C. F. Langworthy has had charge of the work performed in the Washington office in connection with these investigations.

The appropriation for nutrition investigations for the fiscal year ended June 30, 1902, was $20,000, an increase of $2,500 over that of the preceding year. The increasing recognition of the importance of these investigations, as knowledge concerning them becomes more widely spread and the general public understands them more fully, is especially gratifying.

The investigations are carried on in different parts of the country. With the aid of the increased appropriation of the past year it has been possible to undertake work in some new regions. According to the policy which experience has shown to be most effective, the work has been done largely in cooperation with experiment stations, agricultural colleges, and universities, some of the leading institutions in the country being included in the list. By this cooperative method of conducting the investigations in different localities the work is given a broader scope and a wider influence than could otherwise be obtained by the expenditure of the amount of funds appropriated for

the work, since usually the cooperating institutions give considerable assistance in the way of the services of skilled investigators, as well as laboratory supplies and facilities.

Following is a list of the cooperators during the year, and of the institutions with which they are connected:

Maine: State University and Experiment Station, Prof. C. D. Woods and associates.
Massachusetts: Harvard University, Dr. E. A. Darling, Mr. Edward Mallinckrodt, jr.
Connecticut: Wesleyan University and Storrs Experiment Station, Prof. W. O. Atwater and associates.
New York: Columbia University, Dr. H. C. Sherman.
Tennessee: State University, Prof. C. E. Wait and associates.
Illinois: State University, Prof. H. S. Grindley.
Minnesota: Agricultural College of the State University, Prof. Harry Snyder.
California: Agricultural Experiment Station of the State University, Prof. M. E. Jaffa.
Vermont: Agricultural Experiment Station of the University of Vermont, Prof. J. L. Hills.
Georgia: State College of Agriculture and Mechanic Arts, Dr. H. C. White.

GENERAL PURPOSE AND PLAN OF THE INVESTIGATIONS.

The nutrition investigations the past year may be divided into four general classes: (1) Dietary studies; (2) digestion experiments; (3) cooking experiments; and, (4) metabolism experiments.

The dietary studies have been conducted in various parts of the United States and have included the study of the diet of people of varying ages and occupations under different conditions. They furnish a large amount of data as to the actual food habits of persons in different parts of the country, give opportunity for comparison with the data obtained in other countries, and aid in establishing general nutrition standards.

The digestion experiments have also been conducted in different parts of the country under widely varying conditions. By means of these experiments, the digestibility of various classes of food materials, such as meats, cereals, legumes, fruits, nuts, etc., is studied, and data are obtained as to the amount of the food material consumed which is made available for use in the human body.

The cooking experiments have been made with meat and have included the study of the effects of different methods of cooking upon meat of different kinds and cuts with reference to composition, digestibility, nutritive value, and pecuniary economy.

The metabolism experiments have been conducted mostly at Middletown, Conn., with the aid of the respiration calorimeter. In these experiments the income and outgo of the body (both matter and energy) were carefully observed and measured under different conditions of rest and work. The questions especially considered this year were (1) the relation between muscular work and the metabolism of nitrogen and (2) the relative efficiency of fats and carbohydrates in the diet for severe muscular work. The results obtained have been unusually interesting and valuable.

All these experiments include a large amount of analytical work, as well as the determination of a considerable number of heats of combustion by means of the bomb calorimeter.

Considerable editorial work is required to put the results of the investigations in form for publication as either technical or popular bulletins, and, as would be expected, the increase in the amount of investigation has also resulted in an increase in the editorial work.

The investigations planned for the year have been completed and for the most part the reports of the results have been received. These reports will be prepared for publication as rapidly as possible.

THE WORK AT DIFFERENT PLACES.

During the past year the work of the Washington office in connection with the nutrition investigations has included a general supervision of the plans and expenditures, editorial work in the preparation of bulletins and in perfecting the details of reports of investigations, the collection and compilation of the results of nutrition investigations not generally available, the collection of bibliographical data and the abstracting of the current literature on nutrition—partly for publication in the Experiment Station Record, the conducting of a large correspondence growing out of nutrition investigations, and the distribution of publications on this subject.

The work in Middletown, Conn., at the office of Prof. W. O. Atwater, special agent in charge of nutrition investigations, has included the planning and direct supervision of these investigations in different parts of the country, the conducting of special investigations with the respiration and bomb calorimeter, the compilation of results of nutrition investigations in this country and abroad, correspondence relating to these investigations, and administrative work.

The special investigations at Middletown were under the more immediate charge of Dr. F. G. Benedict, and as heretofore were carried out in cooperation with the Storrs Experiment Station and with Wesleyan University. They include routine and special analytical work and metabolism experiments, which also comprise digestion experiments and an experimental study of methods of determining water in food samples. Attention has also been given to the improvement of the respiration calorimeter and other apparatus and methods of experimenting.

The principal objects of the investigations with the respiration calorimeter were the study of the relative efficiency of fats and carbohydrates as sources of energy for the performance of muscular work. The observations included also the amount of heat liberated by the body during the period of digestive inactivity as compared with that in the period when digestion is taking place, the metabolism of nitrogen during fasting, and the variations of body temperature under different conditions.

Two series of experiments were carried on during the year. The first, of six days' duration, comprised a work experiment of three days with a diet containing a large quantity of carbohydrates, and a fasting experiment of two days, in which the subject remained as quiet as possible within the respiration chamber. On the day between these two experiments the subject ate part of a day's rations and remained quiet. The second series of experiments covered a period of ten days. The purpose was to compare the values of fats and carbohydrates as sources of energy for the performance of muscular work. On the last day of this series the subject performed an unusual amount of work, sleeping only two hours out of the twenty-four. It is believed that the data furnished by these two series of experiments are especially interesting.

Several of the so-called "check" experiments for testing the accuracy of the apparatus by burning alcohol within the chamber were made during the year. These are believed to be in several respects the most valuable of such check experiments thus far carried on.

In connection with the respiration calorimeter, a number of very important changes have been made. Early in the fall of 1901 plans were drawn for rebuilding the wooden portion of the calorimeter proper, with a view to securing more perfect insulation, easier control of the heating and cooling devices, and accessibility of the interior parts. As remodeled the exterior wooden walls were diminished in size and number, and altogether the system is much less cumbersome than before. The apparatus is now constructed so that it can be entirely taken apart, the copper box rolled out on two tracks, and both the inside and the outside of the respiration chamber made very accessible. This has already proven of great value in making alterations either in the thermal junctions or heating and cooling systems. Entirely new arrangements for the heating and cooling circuits have been installed, including a new form of rheostat for varying the intensity of the electric current passing through the heating wires. An especially effective piece of apparatus is the new form of switch devised by the mechanician, Mr. S. C. Dinsmore. This switch simplifies greatly the observations on the thermo-electric systems, and thus increases their rapidity and accuracy. It was used in the experiments of the year 1901–1902.

A number of minor changes have also been made in the general manipulation of the apparatus.

Inasmuch as the method generally employed for determining water in food samples is defective, a special investigation was conducted to determine if possible a satisfactory method for removing water from substances without causing any disintegration of the chemical molecules of the ingredients of the food. This was a continuation of some work undertaken a number of years ago. The most satisfactory results were obtained by use of a vacuum desiccator. A description of a simple method for obtaining a very satisfactory vacuum was published in the American Chemical Journal for May, 1902.

A large amount of editorial work has been necessary to prepare the reports of the collaborators in different parts of the country for publication. In every case the figures furnished have been verified to guard against the possibility of error, the literature of the subject has been reviewed, and text has been amplified and edited as seemed expedient.

A considerable amount of work has been done in collating and abstracting the results of the work of other investigators and putting the material in form for future publication. For the administrative work centered at the Middletown office and the correspondence regarding the nutrition investigations, as well as the clerical labor required in calculating and editing the results of the metabolism experiments and other investigations, a considerable force is needed.

Prof. C. D. Woods, of the University of Maine, at Orono, has studied the digestibility and nutritive value of flour. During the past two years he has made 33 digestion experiments with bread made from different grades of wheat flour from the same lots of wheat. In connection with his work Professor Woods has also made an extended study of methods of investigation, including the separation of feces. In addition to the digestion experiments Professor Woods has made 4 dietary studies with lumbermen. These men performed severe work under unusual conditions. It is believed the results of the studies will be of interest in the study of the relation of diet to muscular work.

Prof. Harry Snyder, of the University of Minnesota, at Minneapolis, has made investigations along the same lines as those followed

by Professor Woods with flour of different grades ground from soft wheat, using the same samples as those worked upon during the year 1901–1902 by Professor Woods. In connection with these investigations Professor Snyder conducted 15 digestion and nitrogen metabolism experiments with men on bread made from the different grades of flour eaten with milk. As was the case with flours ground from hard wheat, it appeared from the work of both Professor Snyder and Professor Woods that the bread made from fine patent flour was more digestible than that made from the Graham and the whole-wheat flour, though the last two contain slightly more protein and have a slightly greater energy value.

The results agree with those of former years in showing that the fine grades of flour are equal in nutritive value to the coarser grades, the slightly smaller amount of nutrients of the former being compensated for by the superior digestibility which is due to finer granulation. Professor Woods's and Professor Snyder's experiments are of especial interest, since they furnish a large amount of very accurate information regarding a question which has been under discussion for many years, namely, the nutritive value of different sorts of wheat flour. Many experiments had been previously made on this subject by investigators in this country and Europe, but the question was not definitely settled, perhaps owing to the fact that earlier investigators seldom if ever used flours ground from the same lot of wheat. It was, therefore, unfair to assume that the differences in digestibility observed were due entirely to the character of the flour, since flours of the same grade have been found to vary as much in composition as the average values for different grades.

It has also been found by Professors Woods and Snyder that some of the lower grades of flour which are not of a fine white color, and hence are not favorites in the household, yield a bread which contains more protein than the coarse flours, like Graham and whole-wheat flour, and that this bread is also quite thoroughly digested. As these flours are cheap, they are worthy of more attention than they have received, where economy is a matter of importance.

The experiments, as a whole, furnish additional proof, if such were needed, of the high nutritive value of wheat flour of all grades, both in proportion to its bulk and in proportion to its cost. It has been found that flours of all grades are very thoroughly assimilated, and furnish in an economical form the nutrients required for the building and repair of body tissue and the energy necessary for muscular work. The wheat crop is one of the most important of American agricultural products, and it is believed that these experiments, and others which are planned for, will serve a useful purpose in calling the attention of the public at large to the great value of wheat products in the diet and to the comparative value of different sorts of flour.

At the University of Illinois, Prof. H. S. Grindley has continued his investigations on the losses involved in cooking meat of different kinds and cuts and the comparative digestibility of meats so prepared, as determined by natural digestion experiments with man and by artificial digestion experiments under conditions designed to approximate those which obtain in the body. This work has included 19 cooking experiments, 14 digestion experiments with man, and 30 artificial digestion experiments. In connection with the investigation, much time has necessarily been devoted to a study of experimental methods and to analysis of different food and excretory products. The analytical work has included determinations of heats of combus-

tion. Professor Grindley's investigation has shown that meat loses in weight when cooked, the principal material lost being water, though some fat is also lost and a small amount of nitrogenous material and mineral matter. The losses in weight vary with different methods of cooking, as well as with the fat contents; but if the material removed is utilized in the form of gravy or soup it is evident, from the standpoint of food economy, that there need be no waste of nutritive material. It is commonly believed that fried meats are less digestible than boiled or roast meat. In these experiments it has been found that there are small differences in the completeness of digestion, but additional experiments are needed before the comparative digestibility of meat cooked in different ways can be definitely known. The same statement applies to the comparative digestibility of different sorts of meat.

At the University of California, at Berkeley, Prof. M. E. Jaffa has continued his special investigations of the nutritive value of fruit and nuts. Seven dietary studies have been made with fruitarians consuming a diet of these materials eaten raw. Thirty-two digestion experiments have been made also to learn the thoroughness with which fruit and nuts are assimilated. Two of the subjects were old men who had been accustomed for a long time to a vegetarian diet; the others were healthy young men who had been accustomed to a regular mixed diet. The rations studied consisted of single fruits and combination of fruits and nuts. In conducting the experiments with subjects who were used to a mixed diet especial attention was paid to the transition from ordinary diet to vegetarian diet in order that the conditions of the experiment might be regular. In all the digestion experiments the metabolism of nitrogen was also studied. The fruitarians appeared in good health, although their diet furnished considerably less protein and energy than the food of the average American. The studies of the dietetic value of fruits have aroused much local interest in California. They are of special interest in view of the fact that fruits are regarded by many persons as food accessories rather than actual sources of nutriment and are consumed to please the palate rather than for the nutritive material which they contain, although the fact is perhaps also generally recognized that they supply the body with salts, acids, etc., valuable from an hygienic standpoint. Professor Jaffa's experiments emphasize the fact that fruits and nuts may be an important source of nutritive material, although the fresh fruits do not furnish large amounts in proportion to their bulk, containing as they do comparatively large percentages of water. In dried fruits which have been concentrated by evaporation the percentages of nutritive material, especially carbohydrates, are fairly high in proportion to the bulk. So far the investigations have not taken into account such fruit food products as jams, jellies, and marmalades, which, judged by their composition, may furnish the body with a considerable amount of nutritive material. Although the investigations are not yet sufficient in extent for final deductions, it may be said that those already conducted have furnished a demonstration of the nutritive value of fruits and nuts and shown that they may furnish a comparatively large proportion of a nutritious diet for those who desire to use them thus.

At Harvard University, Cambridge, Mass., Mr. Edw. Mallinckrodt, with the cooperation of Professor Sanger, in 1900 carried on dietary studies with 10 students. Some of them were obliged to live very economically. Some editorial work has been done upon the report of

these investigations by Mr. Mallinckrodt during the past year. These investigations were carried on under the general supervision of Professor Atwater.

Several years ago Miss Amelia Shapleigh, under the supervision of Mrs. E. H. Richards, now of the Boston Institute of Technology, carried on an extended series of dietary studies with the families of workingmen. This material, which was never published in detail, has been furnished to this Office and has been edited during the past year, with the cooperation of Mrs. Richards, and is practically ready for publication. The report will also include the results of dietary studies made in 1901–1902 at the Boston School of Housekeeping. The work carried on by Miss Shapleigh and Mrs. Richards is of interest in itself and useful for purposes of comparison, especially in fixing upon dietary standards.

At the University of Vermont, located at Burlington, Prof. J. L. Hills has carried on 5 dietary studies, one with the family of a professional man and the others with farmers' families. The investigation necessitated a large number of analyses.

Prof. C. E. Wait, of the University of Tennessee, at Knoxville, has carried on 4 dietary studies with white families in poor circumstances and 10 natural digestion experiments with men on a diet consisting principally of legumes. The work is in continuation of earlier investigations along the same lines. The dietary studies furnish information regarding the food habits of a portion of the population of this country of which little has been definitely known, and are also useful for purposes of comparison and in a consideration of the problem of the food of man in relation to the production of useful work. The digestion experiments with dried legumes furnish information regarding the thoroughness of assimilation of these materials, which are directly comparable with meat as regards the proportion of protein they can furnish the body. The importance of dried legumes (peas, beans, lentils, etc.) has been recognized since earliest times. The importance of some knowledge of the thoroughness with which these materials are assimilated and the comparative nutritive value of different sorts of legumes is obvious. Very little definite information of this sort was available when the investigations were begun.

Dr. H. C. White, president of the Georgia State College of Agriculture and Mechanic Arts, at Athens, has begun nutrition investigations with special reference to securing information regarding local food habits and food conditions. One 30-day dietary study in the students' mess hall has been completed and additional investigations are planned for.

At Columbia University, New York City, Dr. H. C. Sherman has continued his investigation of the comparative metabolism of nitrogen, sulphur, and phosphorus, the work necessitating considerable study of methods and a large number of analyses. The results obtained have been edited and are practically ready for publication. These experiments, though quite technical, have an important bearing on nutrition, one of the objects being to furnish information on the proteids which are actually metabolized in the body and the length of time which must elapse before the excretion of the cleavage products of proteids consumed at any given time. Closely connected with this is the question of the comparative nutritive value of different proteids of animal and vegetable organisms. In this report is included a review of the general literature of the subject studied.

In a number of instances there has been cooperation with institu-

tions or individuals to the extent of rendering assistance or in an advisory capacity, chiefly through the special agent in charge. For purposes of comparison, some analytical work has been carried on at Middletown with bone proteids and other animal proteids at the request of Prof. W. J. Gies, of the College of Physicians and Surgeons, New York.

In former reports no mention has been made of the fact that dietary schedules and other information regarding the conducting of experiments and nutrition investigations was furnished to Dr. J. C. Dunlop and Dr. D. N. Patton and his collaborators, all of Edinburgh, Scotland. Dr. Dunlop used this material in the investigation included in his report on "Prison dietaries," prepared for the "Prison Commission for Scotland," and Dr. Patton and his collaborators made a similar use of material in "A study of the diet of the laboring classes in Edinburgh," which was carried out under the auspices of the town council of the city of Edinburgh.

Dietary schedules and information regarding the carrying on of nutrition investigations was also furnished to B. S. Rowntree, of York, England, and used by him in carrying on the dietary studies of poor families reported in his recently published volume, "Poverty, a study of town life." During the past year Dr. P. Smolenski, of St. Petersburg, Russia, has prepared a summary of all the nutrition publications of the Office of Experiment Stations, as well as a history of this work. This was published by the ministry of interior of the Russian Government. Instances like the above are noteworthy, since they show the interest manifested by scientists at home and abroad in the nutrition work of the Department.

In furthering the interests of the nutrition investigations, Professor Atwater has attended a number of conferences and has delivered a number of lectures before educational institutions and learned societies, etc. The following should be mentioned:

Lake Placid Conference on Home Economics, July 1, 1901; The First Cuban Conference of Charities and Correction, Havana, Cuba, March, 1902; The Federation of Women's Clubs, Buffalo, N. Y.; The Georgia State College of Agriculture and Mechanic Arts, Athens, Ga.; State Normal School of Lucy Cobb Institute; Hartford Medical Society; Medical State Science Teachers' Association; New York Section of American Chemical Society; University Club, Providence, R. I.

In every case lectures have been delivered upon some topic connected with the Department nutrition investigations or closely related investigations. These visits, which were generally made at the invitation of the institution or society visited, are mentioned as one of the indications of the widespread interest felt in the nutrition investigations by teachers, physicians, scientists, persons engaged in philanthropic enterprises, and others.

Closely connected with the nutrition investigations, though not directly a part of them, may be mentioned the summer school of nutrition and bacteriology, which was held at Wesleyan University, Middletown, Conn., in July, 1902, and in which several of the officers of this Department took part. This school was attended by students from different regions, a considerable number of whom are teachers of domestic science, and others who have engaged to a greater or less extent in the teaching of nutrition, chemistry, or bacteriology in the agricultural colleges and other institutions. The school was thus an effective agency for the dissemination of information regarding the nutrition investigations of this Department.

FOOD AND NUTRITION PUBLICATIONS.

Four technical and one popular bulletin were published during the year, in addition to one article contributed to the Yearbook for 1901, and a history of the development of the nutrition investigations prepared for the annual report of this Office.

Studies on Bread and Bread Making at the University of Minnesota in 1899 and 1900 by H. Snyder (Bulletin No. 101, pp. 65, pls. 3, fig. 1): This bulletin gives a report of the continuation of the investigations at the University of Minnesota on bread and bread making and on flour and its relation to bread. The special subjects considered are the comparative nutritive value, including both composition and digestibility, of graham flour, entire-wheat flour, and standard roller-process flour; the comparative digestibility of bread and of oatmeal in experiments with a ration consisting of large, medium, and small amounts of bread and milk and large and small amounts of oatmeal and milk; the digestibility of bread made from flour in which the proportion of starch is increased; and the quality of bread as affected by increasing or diminishing the proportion of starch, by raising or lowering the temperature of the flour, by prolonged heating of the flours, and by blending of different types of flour. The investigations reported form an unusually satisfactory basis for judging the comparative nutritive value of graham flour, whole-wheat flour, ordinary patent flour, and blended flours.

Experiments on Losses in Cooking Meat, 1898–1900, by H. S. Grindley (Bulletin No. 102, pp. 64): But little study has been made of the effect of cooking upon the composition and digestibility of meat, and exact data have been lacking. A series of investigations have been begun at the University of Illinois by Professor Grindley and his associates upon this subject. Only a partial report of the investigations in 1898–1900 are given in this bulletin, the results of 25 experiments upon the losses of meat in cooking being reported. Later publications will give reports of the rest of the investigations during those years and of investigations which are now in progress. The results here reported, though not final, are valuable and of much practical importance.

Nutrition Investigations among Fruitarians and Chinese, by M. E. Jaffa (Bulletin No. 107, pp. 43, pl. 1): This bulletin contains two articles. The first reports the results of six dietary studies with fruitarians, a digestion experiment, and a nitrogen metabolism experiment. The subjects (two women and three children) had lived almost entirely on raw fruit and nuts for several years, one of the children having lived upon such a diet since infancy. It was found that although the diet furnished less protein and energy than the mixed diet of similar individuals, the subjects were apparently in good health.

With a view of learning something of the dietary of Chinese living in California and its relation to muscular work, studies were made of a professional man, that is, a man with little muscular work; a laundry association, that is, individuals performing moderately severe muscular work, and employees on a truck farm, that is, men performing severe muscular work. The foods eaten were found to furnish practically the same amounts of protein and energy as has been found in the average diet of Americans performing similar amounts of work; the selection of foods was, however, quite different. Generally speaking, rice took the place of bread and similar carbohydrate

foods in the ordinary American diet. Meat and vegetables were used in addition to rice. In the case of the professional man's family and the laundry association the effect of environment was more marked than in the case of the truck-farm laborers—that is, the diet of persons residing in or near a large town was more influenced by American conditions and more American foods were eaten than was the case with the men living in the country.

Experiments on the Metabolism of Matter and Energy in the Human Body, 1898–1900, by W. O. Atwater and F. G. Benedict (Bulletin No. 109, pp. 147): Continuing earlier work, experiments are reported which test the accuracy of the respiration calorimeter and metabolism experiments with man in which the balance of income and outgo of nitrogen, carbon, and energy was determined, the special object being to compare the nutritive value of fats and carbohydrates. Nine such metabolism experiments were made. The work is reported and discussed in detail, the bulletin concluding with summaries on the following topics: Food materials supplied and consumed and the differences in demand by men at rest and at work; the total elimination of water during day and night under different conditions of work, as well as the proportion of the total amount eliminated in the respiratory products and as perspiration; elimination of carbon dioxide during day and night and during different conditions of work and rest; the elimination of energy as heat and external muscular work; the amount of energy liberated by the body at different periods of the day; the relation between the elimination of heat and carbon dioxide in the body. In connection with this discussion a number of average values are given, such as those for the diurnal variation in the amount of water eliminated in the respiratory products. Similar values based on less experimental data have long been quoted in tables of physiological constants and general text-books. The present bulletin, it is believed, supplies values which are much more reliable than those which have been generally quoted in the past.

Principles of Nutrition and Nutritive Value of Food, by W. O. Atwater (Farmers' Bulletin No. 142, pp. 48): This bulletin includes a discussion of the general principles of nutrition, dietaries and dietary standards, digestion experiments, the comparative nutritive and economic value of different foods, effects of cooking and related topics, the whole being designed as a summary of results obtained up to the present time in the nutrition investigations conducted under the auspices of this Office.

Dietaries in Public Institutions, by W. O. Atwater (Yearbook, Department of Agriculture, 1901, pp. 393–408): The general problem of feeding large numbers of persons under uniform conditions is discussed and work which has been carried on along such lines summarized with especial reference to the author's investigations conducted in New York State asylums for the insane under the auspices of the State commission in lunacy. It was found that in many cases it was possible to materially improve the diet and at the same time lessen its cost.

Scope and Results of the Nutrition Investigations of the Office of Experiment Stations (Annual Report of the Office of Experiment Stations, 1901, pp. 437–482): The purpose and scope of the nutrition investigations conducted under the auspices of this Office is outlined, and the methods of conducting the investigations recorded and the results obtained to date discussed. The report also contains historical and descriptive matter concerning all the investigations conducted

at Middletown, Conn., and elsewhere by those cooperating with the Office, a discussion of the editorial and other work carried on at the office in Washington and a brief description of all the bulletins and other publications issued.

In addition to the above, the two following reports were prepared for publication during the year:

Dietary Studies in New York City, 1896–97, by W. O. Atwater and A. P. Bryant (Bulletin No. 116, pp. 83): This bulletin reports and discusses 36 dietary studies made of families living in the thickly congested districts of New York City. Some of them had fairly large incomes, others were in destitute circumstances and almost without exception may be included among the families commonly receiving assistance from charitable organizations.

Experiments on the Effect of Muscular Work upon the Digestibility of Food and the Metabolism of Nitrogen conducted at the University of Tennessee in 1899–1900, by C. E. Wait (Bulletin No. 117, pp. 43): This investigation, which is a continuation of earlier work, is designed to show the effect of muscular exertion upon the digestibility of food and the metabolism of nitrogen. Nine digestion experiments and nine metabolism experiments with men were made. In addition to the above an investigation is reported of the possibility of preparing a composite sample which shall adequately represent the composition of a mixed diet, and thus simplify the analytical work connected with determining the composition of the diet.

PLANS FOR THE FISCAL YEAR 1903.

In the investigation at Middletown it is proposed to continue, with the aid of the respiration calorimeter, the study of the comparative value of fats and carbohydrates as sources of energy for muscular work, and in general to develop the respiration calorimeter investigations as far as possible along the lines suggested by the work of former years. Administrative and editorial work will be continued as usual.

Professor Woods, at the University of Maine, and Professor Snyder, at the University of Minnesota, will continue their investigations on the digestibility and relative nutritive value of different grades of flour ground from the same sample of soft wheat. The University of Minnesota has completed a new chemical laboratory, of which a portion has been set apart for Professor Snyder's nutrition investigations. A small mill will be purchased in which wheat can be ground in the same way as is followed commercially. This will secure better samples of flours than could be readily secured in the past, and will much facilitate Professor Woods and Professor Snyder's investigation. As has been the case in the past, Professor Woods will devote attention to the study of metabolic products in connection with the digestion experiments.

Professor Grindley, at the University of Illinois, will continue his studies of the changes in composition and digestibility of different kinds and cuts of meat brought about by various methods of cooking. In addition such analytical work and comparative studies of methods will be carried on as are required. The University of Illinois is constructing a new chemical laboratory in which two laboratories have been set apart for nutrition investigations. This is an indication of the way in which the work is regarded by the university. Interest in work on meats at this institution is further shown by the fact that a

State appropriation has been secured for investigations by the Illinois experiment station on the effect of fattening cattle upon the food value of the carcass. This work is directly in line with that carried on by Professor Grindley, and it is expected that in the future his samples of meat will be secured from cattle fattened and slaughtered under definite conditions, which will greatly add to the importance of the results obtained in the special cooking experiments. In connection with Professor Grindley's work, it is expected that Miss Isabel Bevier, professor of domestic science in the university, will endeavor to make a practical application for housekeepers of the results obtained by Professor Grindley.

In addition to completing the work called for by his authorization covering the last fiscal year, Professor Jaffa, at the University of California, has accumulated a considerable amount of material, which will be used in his work for the fiscal year 1903. The material includes samples of food and excretory products from digestion experiments on the nutritive value of fruits. His time will be largely devoted to the study of this material and the preparation for publication of the results already obtained, the material being amply sufficient for the purpose.

At the University of Tennessee, Professor Wait will continue his dietary studies of white families in poor circumstances, until sufficient information of this character has been accumulated for purposes of comparison and for use in fixing upon dietary standards. His work also includes a study of the comparative nutritive value of dried legumes, such as cowpeas, beans, lentils, etc., ordinarily eaten.

President White, at the Georgia State College of Agriculture and Mechanic Arts, will continue dietary studies with the special object of securing information regarding food habits of persons in different circumstances under the local conditions.

It is expected that Dr. H. C. Sherman, at Columbia University, New York City, will continue his studies of the comparative metabolism of nitrogen, sulphur, and phosphorus, although definite arrangements for this work have not been made.

Mr. J. P. Fox, of Boston, Mass., has recently submitted to the Office some results of dietary studies made under special conditions which are of considerable interest. He will continue this work, and it is believed that additional material of interest and value will be forthcoming.

In addition to the above, there are two other lines of work which it seems especially desirable to undertake, namely, dietary studies in public institutions and nutrition investigations in the Tropics. Plans for beginning the work in public institutions have already been made, and considerable material, including summaries of results of earlier investigations, etc., has been collected, which will prove useful for purposes of comparison. By an arrangement with Dr. A. B. Richardson, superintendent of the Government Hospital for the Insane, in the District of Columbia, dietary studies will be made in that institution during the current year in accordance with plans furnished by this Office.

It is believed that the results of nutrition investigations already made may be practically and beneficially applied in a wide way to the feeding of men wherever a considerable number of persons are to be fed on a systematic plan. This applies especially to boarding schools, college clubs, reformatory and penal institutions, hospitals for the insane and other dependent classes, and the Army and Navy. A

beginning has already been made in this direction, but there is still room for a large amount of investigation before definite suggestions of general application can be made.

The providing of the proper diet for prisoners and inmates of insane asylums and other institutions has long received attention, although its systematic study is comparatively recent. Some years ago special investigations of the diet of the insane were undertaken in Russia. Some work was also carried on in Germany. Special interest attaches to the recently published report of the diet of pauper lunatics in asylums and lunatics of poorhouses in Scotland, which gives the details of investigations carried on under Government authority. Perhaps the most important and extended investigation of this nature is that recently conducted in the hospitals for the insane in the State of New York, in which the special agent in charge of our investigations has already made some studies under State auspices. The annual cost of the food supply to these hospitals has been over $1,000,000. The investigations already made show that not only may the total cost be considerably reduced and large wastes prevented, but that the dietaries of the inmates of these institutions may be much improved by attention to the facts and principles established by nutrition investigations. These investigations have also shown the need for more accurate inquiries regarding the food requirements of different classes of persons in these institutions. In the State of New York alone not far from 100,000 people of the dependent and delinquent classes are maintained in public institutions at an annual expense of $26,000,000, of which about $6,000,000 is expended for food. This will give some indication of the vast interests at stake in this matter when we take the whole country into account. Certainly here is a field of investigation upon which the Department might well enter, and in which results of great practical value might be expected.

In early times the idea was prevalent that the diet of prisoners and other delinquent classes should be so poor and inadequate that it constituted a punitive measure. This is now recognized as wrong, and most civilized nations endeavor to feed such persons adequately. The food requirements obviously vary with the amount of work performed, and in most cases it is essential that the cost of the food be moderate. Food investigations are required in prisons and other institutions in order that satisfactory dietary standards may be formulated, and also to compare the rations actually fed with proposed standards. The importance of such studies has been often recognized in the past; for instance, under the authority of the institutions' commissioner in Boston, Mass., dietary investigations were carried on in a number of reformatories, etc., in that city. Studies have also been made at the reformatory at Elmira, N. Y., some of which had the special object of determining whether it was possible to favorably affect the moral welfare of inmates through their diet.

Under special government authority the diet in Scotch prisons has been recently studied, and mention may also be made of recent work of a similar nature in Berlin. In many cases it has been found that it is possible to furnish a more satisfactory diet and at the same time diminish the cost.

Nutrition investigations have also been made in almshouses, orphan asylums, and similar charitable institutions in times past in this and other countries, Germany having taken the lead. The importance of providing a proper diet for inmates of such institutions has received government recognition in Great Britain, and investigations bearing

on the subject have been undertaken there. An adequate diet should unquestionably be supplied to all who are dependent on charity of this sort. The numerous studies which have been made show that with proper care good food may be provided at a reasonable cost. While the diet in many institutions is undoubtedly satisfactory as regards kind and cost, it is not too much to say that in very many others dietary studies would show the possibility of diminishing the cost and at the same time improving the quality. The increase in comfort and the saving of public money in this way seems worthy of all possible effort.

In previous reports I have called attention to the fact that investigations were needed to determine the food habits and requirements of residents of tropical countries. This matter is becoming of increasing importance, owing to the continuance of soldiers, sailors, and civil officers of the United States in such regions. This, and the fact that large numbers of our people are called to tropical regions by our rapidly extending commerce, would seem to justify the institution of investigations to determine the most suitable diet under the new climatic conditions. It is well known that a suitable diet is a matter which has a great effect upon the maintenance of good health of old residents in tropical countries, and is even more important for recent arrivals. The United States Army has devoted considerable attention to this subject, as have also German, British, and other European investigators, generally under the auspices of the army or navy of their respective Governments. The lack of agreement regarding the diet best suited to residents of the Tropics shows that more extended investigations are required.

The economic feeding of troops and other residents in tropical regions obviously depends in some measure upon the utilization of local food products. Many of these products are comparatively unknown outside the Tropics, and their food value has never been studied. This lack of information should be remedied by comparative tests of the nutritive value of these little-known food materials. Furthermore, we need to study the dietaries of the native populations who have recently come under the jurisdiction of the United States, with a view to determining the relation of their food habits to their health and industrial efficiency. Such investigations may easily become an important factor in the agriculture, trade, and commerce of these regions, as well as in the formulation of plans for the improvement of the conditions of life among these people.

In order to extend the nutrition investigations by carrying on dietary studies in public institutions and among the rural population in different parts of the country, and studies of the food requirements of persons residing in the Tropics, I recommend that $10,000 be added to the appropriation for nutrition investigations for the fiscal year 1904.

Irrigation Investigations.

The extent of irrigation in the United States and the agricultural wealth and population of the arid region must in the end be limited by the economy and skill with which farmers use water, while its success will in large measure be determined by the efficiency and justice with which streams are administered and the rights to their water established and protected. The irrigation investigations of the Department of Agriculture have for their fundamental purpose the betterment of conditions along both these lines. The work is directed

toward helping farmers solve the problems already created, and laying an adequate foundation for the adjustment of the conflicting interests growing out of claims to flowing water which future development will inevitably create.

While the questions dealt with have a vital interest and importance to each individual user of water and to investors in irrigation property, it is also beginning to be realized that they have a larger significance and that their study is required in order to rightly deal with questions which are of both National and international importance. The manner in which water is used in irrigation is destined to have a commanding influence over the social and industrial institutions of one-third of the United States. Not only the agricultural interests, but all other industrial interests of this vast region will be largely influenced in growth and prosperity by a wise settlement of the irrigation questions which this Office is now studying.

Two causes have operated to create an increased interest in the work being done and to augment the requests for information and advice. One was the drought which prevailed throughout the Middle West in 1901 and which brought to the attention of the farmers of that region the advantages that would accrue from being able to apply moisture at the time when most needed. The other is the desire of the arid States for the creation of conditions which will make it possible to fully develop the water supply and apply it to beneficial uses, and which will at the same time protect all existing rights to water so far as they are based on beneficial use, whether they are the result of the ownership of riparian lands in some States or of compliance with the laws of appropriation in others.

The need of a prompt settlement of these questions has been rendered more imperative by the legislation of the last Congress, which set aside the proceeds of the sales of public lands for the construction of National irrigation works. The more rapid our development the greater the need of laws and customs under which titles to water shall be stable. To secure these results the nature and extent of water titles should be better understood and more clearly defined than at present. So long as streams furnish more water than irrigators can use, rights to their flow receive little attention; but with the construction of storage works to restrain the floods and the building of more canals than streams can supply, when titles have to be established to both the stored supply and the portion used without storage, when not only the diverse and conflicting interests of individuals and communities have to be reconciled, but the boundary line between the water supplies used in private and public works has to be marked out, the questions of irrigation law and irrigation administration assume an overshadowing importance. It is a source of gratification that the West is clearly awake to its needs in these directions. Active and influential associations for the reform of irrigation laws, of which the California Water and Forest Association is a conspicuous example, have been formed in California, Utah, Montana, and Arizona, and civic associations having other interests as well are giving much attention to this subject.

THE NEED OF ADDITIONAL FACTS.

The first need, in laying the foundation for future development, is for the facts on which it must be based, and it is these facts which this Office is endeavoring to secure through the irrigation investigations.

Because of the complex issues which have to be dealt with, the primary requisite is capable and experienced men, and the Office has enlisted in its service a number of irrigation engineers and scientists having a National and even an international reputation. The services of men of this character would have entailed a prohibitory expense had it been necessary to employ them continuously. This has been avoided, however, through cooperation with the State engineers' offices of the different arid States and with the State agricultural colleges and experiment stations throughout the country.

MEASUREMENTS OF THE DUTY OF WATER.

At the beginning of the work the duty of water was made a leading subject for investigation, because, in dealing with irrigation from any standpoint (administrative, engineering, or agricultural), the water master, the engineer, or the farmer soon comes to the point where it is necessary to know approximately how much water is needed for an acre of ground.

Two States, Nebraska and Wyoming, have already passed laws limiting the quantity of water which may be appropriated for a given area, while all the other States where irrigation is necessary have laws prohibiting waste and limiting rights to water to the quantity which can be used beneficially. Those charged with the distribution of the water supply must know what is beneficial use and where waste begins.

The irrigation engineer needs to know more than the theoretical carrying capacities of ditches of various sizes and grades and the cost of excavation in different materials and of different classes of construction. He must know how much land the water carried by his canal will serve. The basis for all the computations of the engineer must be the quantity of water required for an acre planted to the crops which it is proposed to raise.

The farmer, at the very beginning of his experience with irrigation, must know how much water he needs and when he needs it. If he builds his own canal, he must know how large to make it; if he buys water from a large canal, he must know how much to buy. Building too large a canal or paying for more water than he needs is throwing money away, while farming with too little water is equally disastrous. The tendency of farmers seems to be to use all the water that can be obtained, often to the injury of their crops and lands. Such farmers need to be shown the better results obtained by others who use water economically.

This Office is now measuring the water used in irrigation in all of the arid States but one, and in a number of the humid States. The results secured in the past three years, while not conclusive, have already done much to educate farmers and ditch managers as to the direction from which improvement of methods and practices must come. It also shows that it is possible to obtain an average duty which will serve as a basis in the establishment of rights, and be a reliable guide for the planning of irrigation works and for the distribution of streams between individuals, communities, and even different States.

While there are wide variations between farms and different localities, the averages show a remarkable uniformity. The records show that nearly one-half of the water diverted from streams is lost through leakage and evaporation in canals. Measured at the head gate, the

maturing of cultivated crops has required the diversion of enough water to cover all the land irrigated to a depth of slightly more than 4 feet. Measured at the margin of fields, the water actually applied has amounted on the average to a little more than a depth of 2 feet. The greatest source of loss, therefore, is through leakage from canals, and while this can not be wholly prevented, it is certain that in time it can be largely reduced whenever the increasing value of water will make it profitable to introduce betterments hitherto not regarded as necessary.

These improvements will benefit irrigated agriculture in two directions. The water now lost through leakage from canals returns in many instances to the surface on the lower-lying fields, converting what were formerly productive areas into unsightly swamps and marshes, which, for the time, are practically worthless. It will also make it possible to apply to beneficial use a large percentage of the water supply which is now lost through evaporation from these over-irrigated areas. One of the next steps in irrigation development, therefore, is the better construction and operation of canals, and one of the leading lines of work in these investigations is the measurement of losses from seepage and a study of the methods of canal construction and operation by which it can be prevented.

DRAINAGE SURVEYS AND INVESTIGATIONS.

In all of the irrigated countries of Europe, drainage and irrigation go hand in hand, and there is every reason to believe that this will ultimately be the practice of this country. The irrigation code recently formulated by the commission created for that purpose in California has made the same board both a drainage and an irrigation commission, and in the irrigation investigations of this Office it has been found desirable to supplement the studies of seepage by kindred studies of the problems of drainage, by which the waters thus lost can be made available and the areas rendered unproductive brought again under cultivation.

The drainage problems connected with irrigation differ in some respects from those where the surplus water supply comes from rainfall. The water which leaks from canals, or sinks into the subsoil from overirrigated fields, when it reappears, comes from below instead of coming from above as in humid districts. In some instances complete relief can not be obtained by providing channels for its removal. The water lost from canals must be intercepted before it reaches the surface, and this necessitates different engineering methods from those prevailing in the East. What these methods must be is as yet largely unknown. They can only be determined by careful study.

Because Eastern drainage methods will not answer, many of the attempts thus far made have proven failures and have led to the belief that the drainage of irrigated lands is impossible. The lesson of these failures is, however, as valuable as what has been taught by success in other localities, and both are being studied by the agents of this Office.

The benefits which are to come from drainage in the older irrigated States, like Colorado and California, are not realized except by a few who are familiar with the extent of the areas rendered unproductive and with the growing encroachment of the surplus water supply on the lands now being cultivated. In response to petitions which embraced practically all of the agricultural and horticultural interests

of the valley of Kings River in California, one of the most important irrigated sections of the United States, a comprehensive drainage survey has been carried on this year for the relief of the overwatered lands. A large and well equipped party, under the direction of Prof. O. V. P. Stout, agent and expert, has been at work determining the losses from canals and how the surplus supply could be removed in the most effective manner at the least cost.

The execution of a plan for a cooperative study of the drainage problems of Colorado, which has been under consideration for several years by Hon. A. J. McCune, State engineer of Colorado, and the chief of the irrigation investigations of this Office, has been begun under the direction of C. G. Elliott, drainage engineer, and the results already secured make it certain that they are to be worth many times their cost in the success of irrigation and the ultimate extent of the reclaimed area.

STUDY OF IRRIGATION LAWS.

The study of irrigation administration in Utah has been completed, and the report on the irrigation laws and practices of the pioneer Commonwealth of the Rocky Mountain region will be published in the near future. A beginning has been made in the study of the irrigation system of Colorado through the preparation of a report on irrigation in the valley of the Big Thompson River, made under the direction of the State engineer's office of Colorado and written by Hon. John E. Field, assistant State engineer. It gives in detail the history of irrigation administration on that stream, the manner in which the rights to water were acquired and established, the problems growing out of their protection, the issues which have given rise to litigation, and the nature of the court decisions. The nature of the agriculture and the problems created by its development along this river are typical of all eastern Colorado, and the lessons taught by the detailed facts disclosed by this report will serve to show just what is the strength and weakness of the Colorado system.

Another important report on irrigation in Colorado has been prepared for this Office by the Hon. J. Sire Greene, ex-State engineer of Colorado. It deals with the water-right contracts of irrigation companies, as illustrated by irrigation practice in the valley of the Arkansas River in Colorado.

An investigation of water rights and the administration of streams has been carried on in Montana under the direction of Prof. S. Fortier, director of the Montana Agricultural Experiment Station and an irrigation engineer of extended experience. In this work Professor Fortier has had the assistance of Mr. Arthur P. Stover, of this Office. This report will give the history of irrigation, from its beginning to the present time, in the valley of the Gallatin River and its tributaries in Montana. It will show the results which have been secured, the character of the rights established, the controversies and unsettled issues which have been created, and will aid the people of that State in determining whether or not changes are desirable, and if so, the nature of the reforms to be secured.

The legislature of Nevada at its last session made an appropriation for cooperative work between the agricultural experiment station of Nevada and this Office in a study of the irrigation problems of Nevada. Prof. A. E. Chandler, resident agent of the irrigation investigations in Nevada, has been gathering the facts showing the extent of the

claims and the actual beneficial use of water along the Carson and Walker rivers.

At the request of the California Water and Forest Association and of others interested, the chief of the irrigation investigations, Prof. Elwood Mead, has acted as a member of a commission to frame an irrigation code for the State of California, and has also devoted much time to giving advice and assistance to similar movements in other States.

The recognition of the value of the work of the Department in promoting the enactment of better laws, and the attention paid to its publications and suggestions, has been most gratifying. That it will have an important influence for good on the future industrial life of the arid West can not be doubted.

IRRIGATION LAWS AND CUSTOMS OF OTHER COUNTRIES.

The first of the studies of irrigation abroad was made by Mr. C. T. Johnston, assistant chief of irrigation investigations, whose report on the irrigation methods and problems of Egypt will soon be published. It compares the conditions of Egypt and those of the arid West, paying special attention to the methods of diverting and using water by irrigators, the duty of water and value of its products. Among the agricultural engineering features of this report will be a description of the recently completed storage dam at Assouan and some of the large diversion works below. The contrast between one of the oldest irrigation systems in the world and one of the newest is pointed out, and farmers are enabled to determine how far Egyptian experience can be made to apply to this country.

RICE IRRIGATION.

During the present season Mr. Frank Bond, irrigation assistant, has continued his studies of rice irrigation in Louisiana and Texas. These embrace measurements of the water used in irrigation, the cost of lifting it from streams into the canals, tests of the efficiency of pumps, and other practical problems involved in determining how far and by what means this new industry can be most successfully extended. His researches have shown the importance of adequate laws to govern the diversion of streams, both as a protection to the present users of water and as a guide to those proposing to make investments in the future. The scanty rainfall of the present season, together with the rapid expansion of this industry, will make the report of this year's measurements more than usually instructive.

IRRIGATION INVESTIGATIONS IN THE INSULAR POSSESSIONS.

An extensive correspondence with parties interested in the recently acquired insular possessions has been carried on, and Mr. Jared G. Smith, special agent in charge of the Hawaii experiment station, has collected a large amount of data on the use of pumps for irrigation in the cultivation of sugar cane in Hawaii, and has submitted a report for publication.

IRRIGATION IN THE HUMID DISTRICTS.

The results of irrigation in the humid States for 1901 were most encouraging. In eastern Nebraska, where crops are generally grown by rainfall alone, the yields of the irrigated fields were more than

double those of the unirrigated. In Wisconsin the net increase in the value of crops due to irrigation was $20 an acre for hay, $11 an acre for corn, and $73 an acre for potatoes. These were exceptional because of the drought which prevailed, but there is reason to believe that in growing high-priced products, and crops which require a large amount of moisture, irrigation is destined to be very largely employed.

WORK OF THE IRRIGATION INVESTIGATIONS FOR 1902 AND 1903.

The increased demand for information has furnished conclusive evidence of the value of these investigations, while their efficiency has been promoted by the legislation of Congress last winter, which both broadened their scope and made their aims more definite. The studies of the laws under which rights to water are established and streams are divided have assumed a new importance through the extension of National aid in the construction of irrigation works, and in order to better direct these investigations the arid region has been divided up into three districts. The headquarters of the central district, or the Rocky Mountain region, is at Cheyenne, Wyo., with Mr. C. T. Johnston, assistant chief of irrigation investigations, in charge. The western district will be under the direction of Prof. J. M. Wilson, assistant professor of irrigation engineering, University of California, Berkeley, Cal. The northern district is under the direction of Prof. S. Fortier, director of the Montana agricultural experiment station, Bozeman, Mont. This arrangement brings about a somewhat more direct supervision in sections having like climatic conditions, and also enables Prof. Elwood Mead, chief of the investigations, to give more of his time to the broader problems connected with the organization of the irrigation industry, which is necessary to the best and largest use of the great rivers of the West.

INTERSTATE WATER RIGHTS.

The appropriation for these investigations provides for a report on the laws affecting irrigation and the rights of riparian proprietors. One of the most complex questions connected with these laws is their relation to the use of interstate streams. Where rivers flow through two or more States, different State laws control the same water supply. In some instances these laws conflict, as is the case where the common law doctrine of riparian rights is recognized in one State and the doctrine of appropriation in another State. Neglect to provide by law for an adjustment of these conflicts will inevitably lead to numerous and costly contests in the courts in the near future. Ignoring the gravity of these problems will not answer. The policy of doing nothing will not serve. The first essential to a satisfactory settlement of these issues is an accurate knowledge of existing conditions. To gather this information is a matter involving care, time, and a considerable outlay. The whole West can not be taken up at once. One stream must be studied at a time. It is desirable, therefore, that the problems first reported upon should be both important and representative.

The North Platte River and its tributaries fulfills these conditions and presents both a convenient and an instructive example of the complications growing out of Western civilization. It flows through three States; three codes of water laws affect the use of its waters. In one State the riparian doctrine is recognized; in the other two it has been abrogated. Each State makes claim to all the waters within its bor-

ders, and each is alike powerless to adjust complications beyond them. A report is to be made on the water laws which control the use of this river. This report will describe how and where water is being used and how this use has changed original conditions. It will explain the nature of the rights to water and the methods employed in their protection. The solution of the issues which will be disclosed belongs to the State legislatures and to Congress, and it will not be the purpose of this investigation to anticipate or influence legislation, except so far as the facts themselves exert such influence.

The State authorities of all the States directly concerned have been conferred with and have expressed their desire to have this investigation made and their willingness to cooperate in its prosecution. The open-minded spirit, the desire to have justice done, the anxiety to avert friction and controversy which has been manifested, and the general belief that a full understanding of conditions will preserve rather than injure the rights of present settlers has been a source of much gratification to this Office and promises well for the future of this section.

STUDIES OF IRRIGATION IN FOREIGN COUNTRIES.

The larger problems which will come with the complete use of Western streams which National aid to irrigation insures, and the larger measure of public control which this renders inevitable, gives greater value to the lessons of European irrigation. The people of the West need to know how the older irrigated lands have solved the problems which now confront them. The comparison of the irrigation methods and policies of Egypt with those of this country, contained in the report made by Mr. C. T. Johnston, assistant chief of irrigation investigations, will be followed by similar reports on other countries based on facts to be gathered during the coming year.

RICE IRRIGATION.

The investigations of rice irrigation, both along the Gulf coast and the Atlantic seaboard, have shown the need of continuing these studies. There are a number of problems which materially affect the public welfare and which require impartial and comprehensive study. Among these is the framing of laws to protect the present users of streams against an increase in use which will exhaust the water supply and jeopardize the success of this growing industry.

The need of such legislation has been made plain by the events of the present year. In a number of places the rainfall between June and September, 1902, in the rice district of Louisiana and Texas has been little more than that of the arid States during this period, and this light rainfall, together with the rapid increase in the irrigated acreage, caused a heavy drain on the bayous and streams. It resulted in lowering the fresh-water level until the current of these bayous was reversed, and, instead of fresh water flowing into the Gulf, salt water invaded the bayous to the injury of the crop and the damage of some of the pumps. In normal years these results would not have occurred, but they show the danger from permitting an indefinite increase in the number of pumping plants. If dependence is to be had on the natural flow of these streams, it is certain that they will not supply all the pumps which can be erected along their banks nor furnish water for all the land which can be irrigated. Two things seem, therefore, to be needed. One is a protection of prior rights of the earlier water users, and another is the adoption of all the

agencies which can be employed to conserve the present water supply. During the coming season the investigation will be directed toward collecting facts which will show the sort of legislation needed. They will include collection of data showing how far development can continue without affecting the water supply of present irrigators, the best methods of increasing or reinforcing this supply, the best means of economizing in the use of water, and the methods, if any, by which the ingress of salt water may be prevented.

The report on rice irrigation along the Atlantic coast, which forms a part of Bulletin No. 113 of this Office, will be supplemented by further studies of the economic questions which confront the irrigators of this section. It is believed that pumps can be profitably used for the irrigation of the higher land, and that many of the methods which are now being employed to advantage in Louisiana and Texas can be used here.

COOPERATION WITH STATE AGENCIES.

The efforts of this Office to promote cooperative arrangements with the agricultural colleges and experiment stations and the State engineers' offices will be continued. In this way the results of widely separated investigations can be brought together and order and system in the cooperative work of State agencies promoted. It also enables this Office to avail itself of the services of highly trained scientists at far less cost than would be required to secure their continuous employment. The work of the Office has also been greatly aided by appropriations for irrigation made by the State legislatures of Nevada, Idaho, and Montana, by the cooperation and assistance of different railway lines in the West, and by associations for the reform of irrigation laws.

ORGANIZATION OF THE FORCE.

The organization of the force employed in the irrigation investigations of this Office during 1901 and 1902 is shown in the following table:

Names and post-office addresses of experts and State agents of the irrigation investigations.

Prof. ELWOOD MEAD, Chief of Irrigation Investigations, Washington, D. C.

CENTRAL DISTRICT.

Clarence T. Johnston, Assistant Chief in Charge, Cheyenne, Wyo.

State.	State agents and experts.	Post-office.
Colorado	L. G. Carpenter, director Colorado Agricultural Experiment Station.	Fort Collins.
	A. J. McCune, State engineer	Denver.
New Mexico	W. M. Reed,[a] civil engineer	Roswell.
Texas	J. C. Nagle, professor of engineering, State Agricultural College.	College Station.
Nebraska	O. V. P. Stout, professor of engineering, University of Nebraska.	Lincoln.
Wyoming	B. P. Fleming, Agricultural Experiment Station	Laramie.
Idaho	J. D. Stannard, assistant in irrigation investigations; D. W. Ross, State engineer.	Boise.
Utah	A. F. Doremus, State engineer	Salt Lake.
	E. R. Morgan, agent and expert, irrigation investigations.	Do.
	Frank Adams, assistant in irrigation investigations.	Cheyenne, Wyo.

[a] Agent for 1901.

Names and post-office addresses of experts and State agents of the irrigation investigations—Continued.

WESTERN DISTRICT.

Prof. James M. Wilson, University of California, Berkeley, Cal.

State.	State agents and experts.	Post-office.
California	W. Irving, chief engineer Gage Canal	Riverside.
	E. W. Hilgard, director California Agricultural Experiment Station.	Berkeley.
Arizona	W. H. Code, chief engineer Consolidated Canal at Mesa.	Mesa.
Nevada	A. E. Chandler, professor civil engineering, University of Nevada.	Reno.
Washington	O. L. Waller, professor of engineering, State Agricultural College.	Pullman.

NORTHERN DISTRICT.

Prof. Samuel Fortier, Director Agricultural Experiment Station, Bozeman, Mont.

Montana	Arthur P. Stover, assistant in irrigation investigations.	Bozeman.
North Dakota	E. F. Ladd,[a] professor of chemistry, North Dakota Agricultural College.	Fargo.
South Dakota	A. B. Crane, professor of engineering, South Dakota Agricultural College.	Brookings.

EASTERN DISTRICT.

Wisconsin	A. R. Whitson, professor of agricultural physics, University.	Madison.
Missouri	H. J. Waters, director Missouri Agricultural Experiment Station.	Columbia.
Louisiana	Frank Bond, assistant in irrigation investigations.	Washington, D. C.
New Jersey	E. B. Voorhees, director New Jersey Agricultural Experiment Stations.	New Brunswick.

[a] Agent for 1901.

DRAINAGE INVESTIGATIONS.

C. G. Elliott, Agent and Expert in Charge.

PUMPING AND FARM MACHINERY INVESTIGATIONS.

L. G. C. Mayer, Agent and Expert in Charge.

IRRIGATION PUBLICATIONS.

The irrigation publications actually printed during the year included four technical bulletins, two Farmers' Bulletins, one Yearbook article, an account of irrigation investigations during 1901 for the report of the Director of this Office, and an article on the scope and purpose of the irrigation investigations of the Office for the Annual Report of the Office for 1901. In addition to these there were prepared for publication three technical bulletins. The bulletins and reports actually published during the year were as follows:

Report on Irrigation Investigations in California, under the supervision of Elwood Mead, assisted by William E. Smythe, Marsden Manson, J. M. Wilson, Charles D. Marx, Frank Soulé, C. E. Grunsky, Edward M. Boggs, and James D. Schuyler (Bulletin No. 100, pp. 411, pls. 29, figs. 16), which gives an account of investigations conducted in California during 1900 by this Office, cooperating with the California Water and Forest Association, which consisted of observations by irrigation experts on the existing legal, engineering, and agricul-

tural conditions along nine typical streams used for irrigation in the State.

Report of Irrigation Investigations for 1900 (Bulletin No. 104, pp. 334, pls. 25, figs. 29): This report covers the second year of investigations relating mainly to duty of water. The reports of the field agents also contain a large amount of information on laws and customs, agricultural methods, crop returns, and other subjects related to irrigation. A progress report on the quantities of silt carried by a number of Southern rivers is also contained in this volume. This report has been reprinted in separates.

Irrigation in the United States, Testimony of Elwood Mead, Irrigation Expert, before the United States Industrial Commission (Bulletin No. 105, pp. 47, pls. 12, fig. 1): The statement made before the Industrial Commission deals chiefly with the legal status of irrigation, touching on State control, National aid to irrigation, and the disposal of the public grazing lands. The necessity and possibility for storage are also discussed.

Irrigation Practice among Fruit Growers on the Pacific Coast, by E. J. Wickson (Bulletin No. 108, pp. 54, pls. 10, figs. 7): This bulletin gives the results of a special investigation into the conditions, extent and methods of irrigation as practiced among fruit growers on the Pacific coast.

Irrigation in Field and Garden, by E. J. Wickson (Farmers' Bulletin No. 138, pp. 40, figs. 18), discusses methods of irrigating on a small scale.

How to Build Small Irrigation Ditches, by C. T. Johnston and J. D. Stannard (Farmers' Bulletin No. 158, pp. 28, figs. 9): This is a reprint of an article in the Yearbook of the Department of Agriculture for 1900, entitled "Practical irrigation," giving methods for laying out and building small irrigating ditches, using only such implements as are found on most farms, or can easily be made by the farmer.

Some Typical Reservoirs of the Rocky Mountain States, by Elwood Mead (Yearbook of the Department of Agriculture for 1901, pp. 415–430, pls. 8): This article describes some of the reservoirs of Colorado and Utah, paying especial attention to cost of construction and returns from the use of the stored water.

Scope and Purpose of the Irrigation Investigations of the Office of Experiment Stations, by Elwood Mead (Annual Report, Office of Experiment Stations, 1901, pp. 417–436, pls. 4).

The publications prepared for the printer during the year include the following:

Irrigation of Rice in the United States, by Frank Bond and George H. Keeney (Bulletin No. 113, pp. 77, pls. 28, figs. 10): In this bulletin Mr. Bond describes the rice industry of Louisiana and Texas, and gives measurements of the quantities of water used in irrigating rice. The laws relating to irrigation of the two States dealt with are also discussed. Mr. Keeney's report covers North Carolina, South Carolina, and Georgia, and is almost wholly descriptive.

Irrigation from Big Thompson River, in Colorado, by John E. Field (Bulletin No. 118, pp. 75, pls. 5, fig. 1): This is a study of the water laws of Colorado as illustrated by irrigation from Big Thompson River. Mr. Field discusses more particularly the "water-loaning" law, a recent enactment which has a tendency to unsettle existing rights to Colorado streams.

Report of Irrigation Investigations for 1901 (Bulletin No. 119, pp.

401, pls. 64, figs. 12): This is the third of the annual reports of the irrigation investigations of this Office. It deals chiefly with the duty of water, but contains also reports from four stations in the humid States, and related questions, where irrigation is not a necessity, but a means of increasing the returns from farm lands; a report on the underground water supply of the San Bernardino Valley, California, and the second progress report on silt measurements.

The manuscript for the following publications is in hand: Irrigation Water Contracts, by J. S. Greene; Report on Irrigation in Egypt, by C. T. Johnston; Irrigation Investigations in Utah; and the Irrigation System of the Gallatin Valley in Montana, by S. Fortier.

A list of references to publications relating to irrigation and land drainage has been prepared by the Library of the Department with the cooperation of the Office.

The increasing demand for the irrigation bulletins has rendered it necessary to reprint Bulletins 58, 92, 96, and 100, Congress having ordered an edition of 3,200 of the last named. It has also been necessary to reprint the separates of Bulletins 86 and 104, containing the reports of the first and second years' investigations on irrigation.

While, as the above statement shows, the volume of published matter relating to irrigation has been large, and its distribution wide, the publications have not been the whole or perhaps the most effective means employed in the educational work of the irrigation investigations. The answering of specific inquiries which come to the Department has been a large feature of the work of the office in Washington. The addresses in public meetings in different parts of the arid region, and conferences with officials and others interested, have also been effective agencies for promoting the work. In this way the experience and knowledge already obtained have been brought to bear on the public mind more effectively than heretofore and has resulted in a great quickening of interest in this matter throughout the West.

The increase in the appropriation for irrigation investigations ($15,000) made by the last Congress will be almost entirely absorbed by the growing outlay for publications and the investigations of the rights of riparian proprietors. The broadened scope of these investigations and the increased interest in the questions with which they deal, growing out of the rapid development now taking place, have increased the opportunity for the useful employment of a still larger fund. I recommend, therefore, that $75,000 for the conduct of the irrigation investigations of this Office be asked for in the estimates of the ensuing year.

Agricultural Engineering.

It will be admitted without question that under an advanced system of agriculture successful farming is impossible without a properly laid out farm, thorough drainage, suitable and properly constructed farm buildings, and efficient farm implements and machinery, and yet it may be safely asserted that no feature of our agriculture has received less attention from the organized agencies for agricultural research and investigation—namely, this Department and the agricultural experiment stations—than such subjects as these, which may be classed under the broad term of agricultural engineering.

It may be truly claimed that American inventive genius and mechanical skill have unaided surpassed the world in the construction of farm machinery and stand in the front ranks as regards other lines of

rural engineering. But with the increasing demand for efficient labor-saving devices resulting from the growing scarcity of farm labor, and the organization and development in foreign countries of institutions for the systematic study and improvement of farm machinery, it is important that we should not longer neglect this field of inquiry if we are to meet the reasonable requirements of our agriculture and maintain our supremacy. Systematic investigations of the kind mentioned have been so limited in this country that at present the Department is not in a position to answer the numerous requests for information on these subjects which come to it, and these demands will undoubtedly increase with the growing application of new forms of power to farm work and the development of new kinds of labor-saving machinery. Interest in these subjects is already so widespread that the agricultural colleges and experiment stations are broadening their work so as to include courses of study and investigations in agricultural engineering. They find great difficulty, however, in establishing this work on an efficient basis, because of the lack of definite information in available form. It is believed that this Department might well undertake to collate and publish such information, as well as to institute investigations which will broaden our knowledge of the principles involved in these subjects. Some of the more important lines along which the proposed inquiries and investigations might be undertaken with profit are, as already indicated, as follows:

(1) *Laying out of farms*, including arrangement of fields, location of buildings, water supply, and disposal of sewage.

(2) *Drainage.*—This is a subject of universal application, but the need of study of methods of draining irrigated land to remove excess of water and alkali is especially urgent for the reason that with the rapid extension of irrigation the subject of drainage is increasing in importance. Moreover, the problems encountered under these conditions are different from those which arise in regions where the surplus water to be removed by drainage comes from rainfall. The introduction of an efficient system of drainage of irrigated lands will make productive large areas of land now practically worthless, and will render available for irrigation an important water supply which is now wasted. In response to numerous requests from the irrigated region, the Irrigation Investigations of this Office has undertaken some work along this line, as explained on page 294. While the need of drainage investigations in connection with irrigation is especially urgent, there are many features of the question as applied to humid regions which have been but imperfectly studied.

(3) *Farm buildings*, including the designing of the different buildings required on the farm, with studies of arrangement, materials to be used, and methods of construction. Formerly farm buildings were mainly storage places for implements and products and shelter for stock; with the advance of agriculture farm buildings have become more complex in construction and use, and should be as carefully planned and constructed as factories. Not only is there a wide field for study in the improvement of their design to more perfectly meet the requirements of modern agriculture, but the question of the materials used in their construction must receive attention in the near future. So long as lumber was abundant and cheap wood was the most desirable material, but with the growing scarcity and increasing cost of lumber the time is not far distant when brick, concrete, stone, and metal will have to be considered. Moreover, under modern con-

ditions of high-bred, high-priced stock, the question of stable sanitation, heating, lighting, and ventilation has assumed an importance second only to that of house sanitation; but the data upon which to base an efficient system of ventilation, for instance, are of the most limited and unreliable character. It is believed that a study of the subject of farm buildings will benefit our agriculture not only by the saving of large sums of money in the selection and combination of materials used, but by the adoption of better designs.

(4) *Farm implements and machinery.*—Inquiries which might be profitably undertaken under this head include—

(*a*) Preliminary work in the collection and publication of information regarding the evolution, character, and uses of farm implements and machinery in this and other countries. This is important because the available literature of the subject is scattered, fragmentary, and out of date. A small beginning has been made in this direction in a bulletin on "The evolution of reaping machines," recently published by this Office.

(*b*) Laboratory and practical tests, involving a study of principles of construction and methods of operation of farm implements and machinery with special reference to efficiency and economy. These might very properly include certain strictly technical inquiries regarding the fundamental nature of the various mechanical farm operations with a view to suggesting the best means of performing them with the implements and machines at present available, or with others, the construction of which will be indicated by the results of the inquiries. Such inquiries would require considerable laboratory equipment, but the results obtained would be useful to the farmer by securing for him the most efficient implement or machine for performing the desired operation and to the manufacturer by assisting him in the construction of the desired implements and machines. Other important inquiries which might be pursued in the laboratory and in practical trials are tests of the relative efficiency and best methods of application of various kinds of power (hand, animal, steam, gas, hot air, compressed air, water power, wind power, and electricity) when used in driving different kinds of farm machinery under varying conditions, and comparative tests of different classes of farm implements and machinery when operated under different conditions, with a view to improvement as regards ease of operation, practical efficiency (power required and quantity and quality of work), and durability. Observations on draft under varying conditions would also be an important feature of such tests.

A special line of inquiry in this connection for which there is a rapidly growing demand is that relating to pumps and pumping for supplying water for irrigation and other farm purposes.

From the above brief outline of proposed investigations on agricultural engineering, it will be seen that these inquiries would be more complete and fundamental than any yet attempted in this country. It is hoped that funds to extend the work of this Department in these directions may be provided at an early day, and I would suggest that an initial appropriation of $25,000 for this purpose be asked for to be used during the fiscal year 1904.

REPORT OF THE DIRECTOR OF THE OFFICE OF PUBLIC ROAD INQUIRIES.

U. S. Department of Agriculture,
Office of Public Road Inquiries,
Washington, D. C., August 31, 1902.

Sir: I have the honor to submit herewith the report of the Office of Public Road Inquiries for the fiscal year ended June 30, 1902, together with an outline of the work for the current year and recommendations and estimates for the ensuing year.

Respectfully,

Martin Dodge,
Director.

Hon. James Wilson, *Secretary.*

WORK OF THE YEAR.

The work of this Office during the past year has been continued and extended along the lines laid down in previous reports. The Director and assistants, including the office force and road experts, have been engaged in collecting and disseminating information relating to the various phases of the road question, attending road conventions and other meetings where the subject of road improvement was under discussion, and cooperating with county and State road officials, agricultural colleges, and experiment stations in the construction of object-lesson roads. The correspondence of the Office, including applications for assistance, information, and literature, has been heavier than in any year since the Office was established. In addition to publishing three new bulletins and one circular, most of the publications of the Office have been reprinted, and in some cases three or four new editions have been necessary to satisfy the unusual demand. The special agents and experts of the Office have attended numerous road meetings, and have given advice and assistance in the building of sample roads in many places throughout the country. Owing to the great importance of this practical feature of the work, and to the constantly increasing demands for it, every possible effort has been made to assist in these object-lesson demonstrations in road building

PUBLICATIONS OF THE OFFICE.

An International Good Roads Congress was held at Buffalo, N. Y., September 16–21, 1901, under the auspices of the National Good Roads Association. The proceedings of the convention, containing much valuable information relating to the progress of road construction in the United States and Canada, were published as Bulletin No. 21. The first edition of 10,000 was soon exhausted, and the Office is now sending out another edition of 10,000 copies.

The proceedings of another good roads convention, likewise held in New York State, are to be found in Bulletin No. 22. It was the third annual good roads convention of the boards of supervisors of the State of New York, held at Albany, January 28 and 29, 1902. The special feature of the meeting, embodied in this bulletin, was the information concerning the progress that New York has made toward State aid in road improvement. The State appropriation for this work has been increased from $50,000 in 1898 to $750,000 in 1901.

Another publication completed this year is circular No. 36, containing a list, so far as known, of all National, State, and local road associations and kindred organizations in the United States. The widespread and ever-increasing interest in highway improvement is indicated by the number of these organizations. When this Office was established, in 1893, there was only one National organization and three or four local associations; now there are over 100 organizations, and these include six distinctly National road associations.

Farmers' Bulletin No. 136, entitled "Earth Roads," was also prepared in this Office and published during the year. It contains a number of practical suggestions on the improvement of earth roads, and is illustrated by engravings showing the methods of construction and maintenance of such roads. Over 100,000 copies have already been distributed, and the demand for it is as great as ever. The influence of this publication to those interested or engaged in road work is shown by the many favorable comments that have been received from prominent men throughout the country. W. W. Crosby, road engineer of Baltimore County, Md., said in acknowledging the receipt of a copy of the bulletin:

> It is an exceedingly valuable paper, and I should like your permission to make liberal use of it in a circular I am preparing on the principles of construction and maintenance of roads for distribution among road commissioners of Baltimore County. The principles brought out therein can not be too firmly impressed on the public mind.

Lansing H. Beach, ex-Engineer Commissioner of Washington, D. C., says of the bulletin:

> I have read it with much interest, and believe that you have done good missionary work in stating what you have done and having it published in this form. It ought to do a great deal of good and do away with some of that widely prevalent notion that a road has to be a mud hole unless it can be macadamized at a cost of several thousand dollars per mile.

Stuyvesant Fish, president of the Illinois Central Railroad Company, also writes of the bulletin: "This ought to be sent out to every roadmaster throughout the country."

The following bulletins are in course of preparation:

Bulletin No. 23. Road Conventions in the Southern States and Object-Lesson Roads Constructed under the Supervision of the Office of Public Road Inquiries, with the cooperation of the Southern Railway, during the fall and winter of 1901–1902.

Bulletin No. 24. Proceedings of the North Carolina Good Roads Convention, held at Raleigh, N. C., February 12 and 13, 1902.

Bulletin No. 25. Proceedings of the Jefferson Memorial and Interstate Good Roads Convention, held at Charlottesville, Va., April 2, 3, and 4, 1902.

WORK OF SPECIAL AGENTS OF THE OFFICE.

Prof. J. A. Holmes, of North Carolina, and James W. Abbott, of Colorado, were reappointed special agents of the Southern and Western divisions, respectively, and summaries of their work for the fiscal year ended June 30, 1902, are submitted.

SOUTHERN DIVISION.

During the year Professor Holmes has visited nearly all the Southern States, examining into the character and distribution of the materials suitable for use in road building, the employment of convict labor in road building, the character of road legislation, the condition of the roads, and the status of public opinion in each State. The samples of road material collected were forwarded to Washington to be tested in the road-material laboratory, and the results of these tests, as fast as completed, have been communicated directly to the interested local officials.

In connection with his trips through the different States, Mr. Holmes has attended and presented papers before a number of good roads conventions. He has delivered addresses on road questions before several of the State legislatures and a number of educational institutions. He has endeavored, both by correspondence and through his personal visits, to keep in touch with the State and county officials, and has discussed with them the best plans for road improvement through the use of local materials in the different sections.

The list of persons now corresponding with this Office concerning the good roads movement in the Southern States is large and is constantly growing. Through this correspondence every portion of the South is reached and accurate information concerning the road-building work is promptly collected.

Literature relating to road building is being distributed in all of the Southern States. The organization of local, county, and State road improvement associations is being encouraged, and the members of such associations are aided through the literature and the suggestions sent out to keep up an active educational campaign in behalf of the movement.

One of the special problems taken up during the year by the Southern division is that relating to the improvement of earth roads through the use, and especially the mixture, of such local materials as clay and sand in the coastal or rockless regions of the South Atlantic and Gulf States. It has been found in many cases that quite satisfactory roads can be constructed by spreading clay on the deep sand or spreading sand on clay roads and allowing the wheels of passing vehicles to thoroughly mix and pack the materials. The results of this work have been so satisfactory in several sections that applications are constantly received for road-building experts to be sent to different States to give special instructions in the methods of testing road materials and constructing cheap and efficient farm roads. Owing to the inability of the Office to supply these experts, nearly all such requests have been denied, but in several cases experts have been sent, and with decidedly favorable results. It is to be hoped that during the ensuing fiscal year a much greater amount of work of this kind can be done.

WESTERN DIVISION.

During the last fiscal year Mr. James W. Abbott continued to work on the plan outlined in my last report. He traveled 35,000 miles through South Dakota, Wyoming, Montana, Idaho, Oregon, Washington, California, Arizona, New Mexico, Nevada, Utah, and Colorado, covering as fully as possible the territory assigned him. On one of these trips he made two digressions, one into British Columbia on the

north and another as far as the City of Mexico on the south. He also made two trips to the Office at Washington, D. C., and one to the International Good Roads Congress at Buffalo.

The object sought in his travels was to get into as close touch as possible with the highway situation generally, and to learn the character, under varying physical conditions, of existing roads embraced in this wide field. As a practical road builder, he aimed to study on the ground the various problems presented by geology, topography, and climate of each section. He also endeavored to learn the existing condition of public sentiment and the degree of enlightenment on road subjects, and then the most practical methods by which these might be stimulated and increased. Wherever he went, he sought out the representative men of the community, city, county, or State, the editors of the newspapers, city and county engineers, road supervisors, mayors, executive officers of commercial bodies and industrial enterprises, and professors in educational institutions. Before leaving a community he invariably inspected its roads, in company with someone interested in road matters and posted on local conditions; and after a study of the history of these roads and of feasible plans for their betterment, he offered to the proper officials such advice as seemed pertinent to the conditions. In connection with all this work he found time to visit and address four important road conventions.

Besides preparing a great many articles for the press and supplying material for a still greater number written by others, Mr. Abbott, after an exhaustive study, wrote a monograph on "The use of oil on roads." He also prepared a paper on "Mountain roads as a source of revenue" for publication in the Yearbook of the Department for 1901. Much time and effort was expended on this paper, and it is attracting favorable attention throughout the United States. It is hoped that the article may lead to important results in developing, by good roads and other improvements, the unrivaled scenic resources of this country. Another duty requiring careful attention was the large and increasing correspondence on matters pertaining to road improvement. The universal interest in the subject, everywhere aroused, has naturally led very many people to write letters to Mr. Abbott asking for information. Many of these letters have dealt with the need for legislation and the tentative efforts in that direction in his especial field.

Being an enthusiast in the good roads cause, Mr. Abbott devoted all his time to this work. Consequently, the sum of $1,500, available for payment for his services, was actually used in paying his expenses.

ROAD-MATERIAL LABORATORY.

The laboratory for the testing of road building materials, established in December, 1900, through the cooperation of this Office and the Bureau of Chemistry, is now in full operation, and any citizen of the United States interested in the construction of public highways can have road materials tested free of charge.

These materials are subjected to an abrasion test to determine their resistance to wear, a cementation test to determine their cementing or binding power, a toughness and a hardness test. Other information regarding materials is also furnished to applicants, such as density, absorptiveness, and proper nomenclature.

COOPERATION IN BUILDING OBJECT-LESSON ROADS.

In addition to making scientific tests of road-building materials, the Office has, during the past year, cooperated with the local authorities in many different States in building short sections of object-lesson roads, thus determining not only the best available materials for any particular community, but also demonstrating their practical application to the road. In this work it is intended not only to contribute something by way of cooperation on the part of the General Government, but also to secure cooperation on the part of as many different interests connected with the road question as possible. The local community having the road built is most largely interested, and is expected to furnish the common labor and domestic material. The railroad companies generally cooperate, because they are interested in having better roads to and from railroad stations. They therefore contribute by transporting free, or at very low rates, the machinery and such foreign materials as are needed in the construction of the road. The manufacturers of earth-handling and road-building machinery cooperate by furnishing all needed machinery for the most economical construction of the road, and in many cases prison labor is used in preparing material which finally goes into the completed roadbed. The contribution which the General Government makes in this scheme of cooperation is both actually and relatively small, but it is by means of this limited cooperation that it has been possible to produce a large number of object-lesson roads in different States. These have proven to be very beneficial, not only in showing the scientific side of the question, but the economical side as well.

The work of building object-lesson roads, in cooperation with the Illinois Central Railroad Company, through the Mississippi Valley from New Orleans to Chicago, as outlined in the last annual report, was continued into the present year, terminating July 26, 1901, in the construction of object-lesson earth roads and the holding of a convention at Effingham, Ill. During the month of September, 1901, another good-roads train, organized in Chicago and carrying all kinds of modern road-building machinery, proceeded over the Lake Shore and Michigan Southern Railroad to Buffalo, where the machinery was used in the construction of samples of macadam and earth roads on Grand Island, near Buffalo. The good-roads train was on exhibition on the grounds of the Pan-American Exposition during the session of the International Good Roads Congress. This was the first international good roads congress ever held which was attended by European delegates. It was attended by prominent statesmen and officials, road experts, and engineers from various parts of this and other countries, and the results, it is believed, will prove far-reaching in their benefits.

This Office cooperated for a period of about five months during the winter of 1901–1902 with the Southern Railway Company and the National Good Roads Association in an expedition for building object-lesson roads in the southeastern section of the country. The good-roads train left Alexandria, Va., on October 29, 1901, and closed its itinerary at Charlottesville, Va., on April 5, 1902. During the intervening time it traveled over the Southern Railroad and its branches through the States of Virginia, North Carolina, South Carolina, Tennessee, Georgia, and Alabama, a distance of 4,037 miles, stopping at eighteen different places and building as many object-lesson roads. The following places were visited, where conventions were also held:

Winston-Salem and Asheville, N. C.; Greenville and Chattanooga, Tenn.; Birmingham, Mobile, and Montgomery, Ala.; Atlanta and Augusta, Ga.; Greenville, Columbia, and Charleston, S. C.; Lynchburg, Danville, Richmond, and Charlottesville, Va.

The governors of several of the States visited issued proclamations announcing the arrival of the train and urging the people to witness the object-lesson work and to participate in the deliberations of the conventions held. These conventions were addressed by the governors, United States Senators, Representatives in Congress, generals of the United States Army, and presidents of colleges and universities, professional and business men, farmers, and others. The addresses were of an unusually high class and were very instructive, as they covered almost every phase of the road question. Indeed, they were considered of so much importance that many of them are to be published, as heretofore mentioned.

This Southern Railway good roads train was equipped with twelve carloads of the most modern and improved road-building machinery, as well as two officers' cars for the road experts and officials of this Department and the National Good Roads Association, and one camp car for the laborers. The train, its equipment, and operating force were all supplied by the railroad company, while the road-building machinery and the expert operators of the same were furnished by the road-machine companies. In all cases the materials and common labor for the road work were supplied by the local authorities. The Government furnished instruction and scientific information, expert road builders, and didactic literature pertaining to the work. At all the places visited samples of stone, gravel, chert, earth, or shell roads were built, so adapted to the local conditions as to show the best and most economical use of the available materials.

Besides the conventions participated in during the trips of the good roads trains, the Director and assistant director of this Office attended and addressed several other important road conventions during the year, among which may be mentioned the following: The annual convention of the Eastern Ontario Good Roads Association, Ottawa, Canada; the annual good roads convention of the State board of county commissioners, Ocala, Fla.; a convention to inaugurate the construction of stone roads, Saginaw, Mich.; the annual meet of the Highway Alliance and League of American Wheelmen, Atlantic City, N. J., and the annual meeting of the Automobile Club of America, New York City.

In answer to inquiries as to the present condition of the sample roads built in connection with the good roads trains under the direction of this Office, very gratifying reports were received, some of which are as follows:

RESULTS OF ILLINOIS CENTRAL EXPEDITION.

In regard to the sample earth road built in this city in the spring of 1901, I beg to state that nothing has been done to it since completion. Yet it was so built that it is in very good order. Our president, Mr. John Dymond, advised me some time since that the convention held here and the piece of road built had greatly benefited several road committees in our parishes, resulting in their making a number of improvements.—HARRY H. HODGSON, *Secretary Louisiana State Good Roads Association, New Orleans, La.*

The road built last season by the good roads train has done a vast amount of good. People have taken a great interest in it. In connection with same, the board of supervisors have used their efforts to improve all the roads, and as a result we think in time that every road in this county will be put in magnificent condition.—J. W. ROSS, *Secretary Good Roads Association, Natchez, Miss.*

The specimen of good road built under the direction of your Department last year is in good condition and is well constructed. The building of this road has aroused public interest in the improvement and construction of good roads, and there seems to be a general demand for road improvement in this county. I think it will not be a very great while before there will be a concerted effort on the part of the citizens of this county looking to the construction of better roads throughout the county. I find almost a universal desire and demand for it.—STOKELY D. HAYS, *President Tennessee Good Roads Association, Jackson, Tenn.*

The mile of road built here last summer from Elwood avenue to the country club, under the direction of your Office, has proved a very useful object lesson. Your visit and the sample road has awakened interest in the movement throughout the State. As you will remember, when finished it was a beautiful, smooth, solid, earth road. Since then the country club has had it macadamized, and it is as pretty a road as one could wish to see. The building of this road has resulted in the organization of the county good roads association, of which Col. I. B. Nall is president. The Louisville Commercial Club has been actively engaged in promoting this movement for four years or more, and is now, on account of the newly awakened interest, doing more for the cause than ever before.—J. C. VAN PELT, *Secretary Kentucky Good Roads Association, Louisville, Ky.*

RESULTS OF THE SOUTHERN RAILWAY EXPEDITION.

While the enthusiasm worked up when the train was in this city has somewhat subsided, there is still a very healthy interest exhibited in the good-roads work in many portions of the State. The executive committee of the State good roads association, of which I am a member, recently held a meeting at Montgomery and formulated an address to the people with suggestions in regard to the formation of good roads associations in every county in the State. We desire these county organizations to select delegates to attend the convention to be held in Montgomery this fall before the next meeting of the legislature, in order that we may agree upon a system of road laws to supersede the obsolete laws we now have. This movement, I believe, will be productive of practical results, the idea being to have one central State organization, of which the county organizations will be parts and duly represented. To show the interest taken, I am glad to say that every member of the State executive committee was present at the meeting except one, and he was unavoidably absent.—HENRY FONDE, *President Southern Alabama Good Roads Association, Mobile, Ala.*

I have made inquiry of a number of the residents of this city and the vicinity who make use of the model road built under your supervision in this neighborhood. The traffic varies from the passage of a light buggy or wagon to the heaviest hauling, and I find no dissatisfaction expressed with the road by any class of users. As yet we have built no roads since your visit, but I think the example will tell when new construction is begun.—CHARLES MINOR BLACKFORD, Jr., M. D., *Lynchburg, Va.*

It gives me pleasure to say that the increased interest in building and maintaining good roads has been very marked in North Carolina since the visit of the good roads train. Though little actual work has been done, yet from all sections of the State, especially from those sections where the good roads train stopped and conventions were held, numerous inquiries have come to me for information and for copies of the recent road laws passed by our legislature, the adoption of which is optional with the county commissioners. Other evidence of various kinds shows the awakening of our people to the great necessity of road improvement. I am sure of the great value of the work your Office has undertaken, and I wish you continued success.—S. L. PATTERSON, *North Carolina Commissioner of Agriculture and Immigration, Raleigh, N. C.*

The road built north of the city by the good roads train is an excellent piece of work, and is standing the travel beyond my expectation; in fact, it is almost a perfect piece of work. I believe the good roads movement is also growing in almost every county in this State, and within twelve months, in my judgment, its friends will be organized and ready for work. This means a great deal for North Carolina. It will cost in this section to build such roads as we are building, with granite bed in the center 9 inches deep and 10 feet wide, with a dirt driveway 8 feet wide on either side of the macadam, about $2,000 or $2,500 per mile. I wish the good roads train could repeat its circuit this fall through this section. It would do more, in my opinion, to promote the good roads movement than anything that can be done. I hope the good roads movement will

continue to grow throughout the entire country.—P. H. HANES, *President North Carolina Good Roads Association, Winston, N. C.*

With relation to the short bit of road constructed at Charleston by the good roads train, I beg to advise that careful inspection shows it to have well withstood the test to which it has been subjected. You will appreciate, however, that the traffic over this road has not been of a heavy order. The interest in good roads, stimulated by your popular enterprise, is continually extending, and is worthy of the highest commendation. One of the foremost tenets proclaimed in the present gubernatorial campaign is "good roads." I most heartily approve of your work. The greatest benefits are to come to us through ready transportation from the farms to the common carriers.—EARLE SLOAN, *State Geologist, Charleston, S. C.*

RESULTS OF EARLIER OBJECT-LESSON ROAD WORK.

On account of the great importance of the Government's cooperation in this object-lesson road work and the urgent demands that are being made for its extension, it is well to reproduce here, in addition to the above comments on the work of the good roads trains, a few reports upon the sample roads constructed in recent years in the various States under the direction of this Office, in cooperation with the State and the county officials, agricultural colleges, and experiment stations:

As one of the commissioners having this matter in charge, I have been more or less conversant with the sample road put in by the Government in this vicinity a few years since. The work was prosecuted with more or less difficulty at that time because of the lack of proper material for its construction. That portion of it first built has been kept in fine condition without any extraordinary expenditures. Your work was the beginning of a good roads movement which has increased from year to year until Geneva is now provided with some of the best roads in western New York; hence, as an object lesson it certainly has been a work of great utility. It is generally admitted by all of the citizens here that such is the case.—S. D. WILLARD, *Postmaster, Geneva, N. Y.*

The road built under your supervision has given universal satisfaction, and many people have visited here to see the possibilities in public-road building. The whole country has been stimulated to improve the old roads. It is very apparent that good roads can be built in sections where gravel and clay abound. The main object is to educate the people how best to use the material at hand. During our convention here 13 counties were represented, and the good seed was sown broadcast. That it is daily bearing good fruit we are confident.—Hon. FRANK HAMILTON, *Traverse City, Mich.*

I beg to acknowledge with thanks a copy of Farmers' Bulletin No. 136, on Earth Roads. I have read the same with much interest and am glad to see that you present therein an engraving showing the great improvement that was made in our road system here in cooperation with your Office. Our road to-day is as good as it ever was, notwithstanding the fact that it has been in use three years, and has been subjected to a great deal of heavy hauling. I wish you could take a ride over it now and then go out on some of the streets of Knoxville that have been neglected for three years. You would not be surprised, however, at such an experience, as you realize so well the value of good roads.—ANDREW M. SOULE, *Professor of Agriculture, University of Tennessee, Knoxville, Tenn.*

Any work done by the Government officially is generally supposed to be thoroughly and scientifically done. The work here was not only well done, but the public was satisfied with it. The object-lesson road built was superior to any road work done up to that time; but it is only fair to state that since then better roads even than the model have been constructed by the county officials: in fact, good examples are contagious as well as bad ones.—W. J. KERNACHAN, M. D., *Florence, Ala.*

I have the honor to submit the following report on the object-lesson road, built at this college under the direction of Mr. Charles T. Harrison, road expert of the Office of Public Road Inquiries, during the spring of 1900:

The road improved is on the west side of the campus, between the college and the town of Starkville. It is one-third of a mile long, part of it crossing a narrow

valley, and the remainder on a hill or slope. This section of the State is underlaid by rotten limestone 700 feet thick. The surface is a stiff calcareous clay that gets very soft and muddy in the winter. The top of the hill was cut down about 18 inches, and the soil and clay carried in wheel scrapers to the valley, where the road was raised about 18 inches. Sewer pipe was put across the road at three points to allow the water to cross from the upper to the lower side. At two places the sewer pipe is 12 inches in diameter and at the other 24 inches. The roadbed was properly shaped and rolled, after which it was surfaced with 5 or 6 inches of sand gravel, gotten at Columbus, Miss., in the valley of the Tombigbee River. On account of a recent overflow of the river depositing sand in the pit, the gravel was not as good as we had previously gotten from the same pit. After using the road a while some cinders from the power-house boilers were put on the surface. The road is a fairly good one, but not the best.

The gravel cost $5 a car (each car containing about 10 yards) delivered on the side track at the college. Labor cost 60 cents a day for grown men. College teams were used for the work. The items of cost are as follows:

Gravel	$125.00
Sewer pipe	35.80
Labor	74.99
Total	235.79

Since this object-lesson road was built the station has issued a bulletin on Earth Roads, and a great many counties have adopted the contract system for working the public highways.—W. L. HUTCHINSON, *Director Mississippi Agricultural College.*

The object-lesson road built by your Department has been seed sown in good soil. I think it was the first object-lesson road built in Maryland, and it has proven a great and good lesson to our people. I am sure no other plan could teach the road officials of our State so valuable a lesson in so short a time. The road was built in a much-traveled section between Fork and Bradshaw, Baltimore County, where much heavy hauling is done—as much as 5 tons being carried upon one wagon with a 3½-inch tire. It was built by your Office and abandoned by the road mender to go down. While in construction there was held a State "good-roads day," July 30, 1898. Since then not one cent has been put upon it, not even to clean out the side drains nor pick up the few loose stones coming to the surface by constant wear and hard rains. Few persons expected it to be permanent, as your road engineer, the late Mr. E. G. Harrison, used only about 8 inches of stone, while the road previously built was from 14 to 24 inches. It was watched by those interested in good roads, and when they found that it stood the test our people began imitating it. While many of the roads are not constructed entirely upon your plans, they are greatly improved over the old system used before you built the object-lesson road. I feel that the building of this road and the good roads convention held had a great deal to do with bringing about our present good roads law in Baltimore County.—WALTER P. RECKORD, *Reckord, Md.*

PLANS FOR 1902–1903.

It is intended during the current year to continue the work and enlarge its scope so far as the appropriation will admit. We have made only a small beginning in the work desired to be done throughout the country, and there are now on file 70 applications from 25 different States for the practical cooperation and assistance of this Office. In spite of the fact that practically all the expense except that of Government supervision is guaranteed in these applications, it is evident that we shall be able to comply with only a limited number of them—more, however, than in any previous year, because of the $10,000 increase in this year's appropriation. Under these conditions a minimum appropriation by the General Government is used to accomplish a maximum of good results, as it is estimated that for every dollar expended by the Government the local authorities have been stimulated to expend at least $10 in this object-lesson and experimental road work.

Owing to the unusual interest in road improvement now prevalent

in northern Ohio, sample roads are being built under the direction of J. H. Dodge, of this Office, at Leroy, Brunswick, and Dover, in that State. The work will continue throughout the season, and full details concerning it will be submitted in my next annual report.

Object-lesson road work is also in progress at Cumberland, Md., where the Allegany County commissioners have appropriated $5,000 for the purpose. A three-fourths mile section of the Old National Turnpike between Frostburg and Cumberland is being resurfaced under the direction of road experts of this Office. In order that the people of Maryland, and especially of Allegany County, may derive the most practical benefit from this work, August 23, 1902, has been set apart as a "good roads day," and all persons interested in road improvement have been invited to visit these roads while in course of construction, and also to participate in a road convention at Cumberland on that date, which will include a general discussion and exemplification of the science of road construction and maintenance. At another point in Maryland, Chestertown, Queen Anne County, some assistance is being extended to the local authorities in the construction of a road out of furnace slag. This slag can be secured in large quantities from Sparrows Point and can be transported down the Chesapeake in barges. Owing to the scarcity of rock and gravel in this part of Maryland, the experiment at Chestertown is being watched with a great deal of interest, for, if successful, good roads on the Eastern Shore of Maryland will no longer be an impossibility.

As soon as the Maryland work is completed the road experts and some of the machinery operating there will be transferred to Morgantown, W. Va., where the funds have already been raised and the preliminary plans made for the building of about a mile of object-lesson road. At this place we are to have the cooperation of the West Virginia Agricultural College and Experiment Station, the State geological survey, the city of Morgantown, and the road officials of Monongalia County, of which Morgantown is the county seat. In view of the fact that very little scientifically constructed road has been built in West Virginia, it is believed that this work will bring about improved methods of road location, construction, and maintenance.

If our experts complete their work in West Virginia before cold weather they will be sent to Batesville, Ark., for the purpose of directing the construction of a gravel road.

Other applications for assistance, advice, and cooperation in road conventions and road work will be accepted during the winter and spring as the occasion may demand, and as our force and means will permit, confining our operations as nearly as practicable to the South in the winter and to the North in the summer.

An application has recently been received from Hon. Horatio S. Earle, State senator of Michigan and chairman of the Michigan highway commission, for the assistance of this Office in the operation of the Pere Marquette Railway good roads train, which is to tour the State of Michigan building sample roads and holding conventions, but owing to previous engagements, limited force, and lack of funds, we have been unable to comply with this request, even to the extent of furnishing a road engineer, much as we should have liked to do so. However, it was my pleasure to be present and participate in the deliberations of the Michigan Good Roads Exposition at Greenville on July 29, 30, and 31, 1902, where the good roads train started its work of holding conventions and building samples of gravel, stone, and earth roads.

The work of the Illinois Central and Southern Railway good roads trains was also so successful that the management of the Great Northern Railway Company has decided to cooperate with this Office in the operation of a similar expedition over its lines from St. Paul, Minn., to the Pacific coast. The train will be organized in Chicago, leaving there over the Burlington route the last week in August, and proceed to St. Paul, where sample roads will be built, and a State good roads convention will be held September 1–6, 1902, in connection with the Minnesota State Fair. Continuing West, the train will stop at the leading cities along the Great Northern, repeating the building of sample roads and the holding of conventions. The Pacific coast will probably be reached about the first of November. Mr. R. W. Richardson, who had charge of the Illinois Central and the Southern Railway good roads trains for the National Good Roads Association, has been appointed special agent of this Office, and he, in conjunction with James W. Abbott, special agent of this Office for the Rocky Mountain and Pacific Coast division, will accompany the Great Northern train, and I shall give personal direction to its operations.

This expedition of the Great Northern Railway Company, coupled with similar work done by the Illinois Central and Southern Railway companies, indicates a desire on the part of the great railroad companies of the country to do all in their power to aid the Government in cheapening the cost of wagon transportation on the common roads.

RECOMMENDATIONS AND ESTIMATES FOR 1903–1904.

The value of this Office as a central good roads propaganda is now fully recognized by all persons interested or engaged in road work. Scientific and practical road building necessitates not only the consideration of local conditions, such as climate and soil, rainfall and drainage, but also a study of available materials adjacent to the roads in all sections. To transport materials a great distance adds so much to the cost as to render roads scientifically constructed of foreign materials impracticable. Competent road builders should discover and test the available materials and show by practical object lessons how the most good can be made of them with the least possible expenditure of money and labor. The best materials are not always discovered, and thousands of dollars are wasted in this country annually by the use of poor materials where a little expert study and advice would have developed good materials close at hand. The best methods of using these materials are oftentimes unknown, and money is wasted in their improper application. All these things require scientific study and investigation. The people of the country are now interested in this matter as never before, and they are demanding and are sorely in need of authentic information along these lines. Furthermore, the General Government can perform certain duties pertaining to scientific road improvement better than any other agency. Scientific facts ascertained at one time by the General Government will serve for the enlightenment of the people of all the States, and with no more cost than would be required for each separate State to make the investigation and ascertain the facts for itself. Heretofore the limited appropriations for this Office have not been sufficient for carrying on object-lesson or experimental work in more than one place at the same time. During the current year it is proposed to conduct such work in three or four places simultaneously. But at the present rate of progress it will take many years to extend the benefits of this

work to all parts of the Union. The Office will be obliged, during the current year, to refuse assistance to several places in the West and Southwest where aid has been urgently requested, and where it is greatly needed. In order that the work may be hastened so as to reach the far West within a reasonable time, and that we may be able to comply with a greater number of important demands that are being made upon us, it is desirable that the appropriation for the Office be so increased that the work can be carried on in several States at the same time.

I therefore have the honor to recommend that the sum of $75,000 be appropriated for the use of this Office for the fiscal year 1903–1904.

This work appears to be no longer of a tentative character. Year after year it assumes increased importance and wider scope. That it will be a permanent feature of the Department's work seems hardly open to question. It appears fitting that it be given a more definite legal status. I therefore respectfully recommend that the Office of Public Road Inquiries be transformed into a Division of Public Roads.

REPORT OF THE EDITOR, DIVISION OF PUBLICATIONS.

U. S. Department of Agriculture,
Division of Publications,
Washington, D. C., October 1, 1902.

Sir: I have the honor to submit herewith, for your information and consideration, a report on the work of this Division for the fiscal year ended June 30, 1902, together with recommendations in regard to future operations.

Respectfully,

Geo. Wm. Hill,
Editor and Chief.

Hon. James Wilson, *Secretary.*

WORK OF THE YEAR.

RELATION OF THE DIVISION WITH OTHER BRANCHES OF THE DEPARTMENT.

The work of the Division of Publications reflects and must always necessarily represent the activity of the other Bureaus and Divisions of the Department. All the information acquired in these several Bureaus and Divisions by the means at their command finds its expression necessarily in the form of publications which pass through this office. Every enlargement of the scope of work covered by any other Bureau or Division, especially the adoption of entirely new lines of work, involves an addition to the work of the Division of Publications. One of the consequences of this is that the output of work is not controlled by the Editor, whose duty it is in this connection simply to push forward the work with all the celerity possible and to keep it within the bounds of the appropriations controlled by him for the purpose.

In no previous year since the Department was organized has this manifestation of activity in all the branches of the Department been so evident. This is shown by the various statements given under the head of "Statistics of publication work."

PUBLICATIONS OF THE YEAR.

Including publications of the Weather Bureau, 85 in number, and which do not pass through this office, the total number of publications issued by the Department during the fiscal year was 757. Of those handled in this Division, 355 were new and covered 18,184 printed pages; 317 were reprints, and of these reprints 236 were Farmers' Bulletins and aggregated 5,575,000 copies. (See Appendix B.) The increase in the matter edited during the past year, counting pages of new matter, was 25 per cent over 1901 and 75 per cent more than in 1900. The total number of requisitions issued for printing during the year was 3,514, of which 1,014 were drawn on the main office.

In the number of copies distributed the increase was very large. The total number of copies of all publications issued during the year (a list of which is given in Appendix A of this report) was 10,586,580, as against 7,899,281 for the year previous.

INCREASE IN WORK AND ENLARGEMENT OF THE DIVISION.

Notwithstanding the increase in the appropriations provided for last year, the tremendous and unprecedented increase of business necessitated the asking, for the first time in many years, for a deficiency appropriation, both for printing and binding, and for the material and labor in the distribution of documents. Both of these deficiency appropriations were granted, but notwithstanding this generosity on the part of Congress, on June 30, 1902, the closing day of the fiscal year, there remained unfinished printing in the hands of the Public Printer amounting to 112 miscellaneous publications and 47 Farmers' Bulletins, a large amount of the expense of which must necessarily be charged to the appropriation for the present fiscal year.

The great development of the Department in recent years, involving almost its reorganization, and the unprecedented increase in the number and variety of its publications, suggest as appropriate at this time a presentation of the status of this Division as compared with a few years ago. Ten years ago (the year 1893) the total funds controlled by the chief of this Division for printing, and including the salary roll, was considerably less than $100,000, while the work of the Division was purely editorial, and had no connection, save indirectly, with the work of the branch printing office, the division of illustrations, and the document section. The total number of its employees, editorial and clerical, at that time consisted of 7 persons, and the number of publications issued that year, including reprints, was 210, aggregating a total of 2,689,084 copies. Since that time the number of publications has increased to 757 for last year, aggregating a total, as already cited, of 10,586,580 copies. The division of illustrations and the document section and the supervision of the branch printing office have all been merged in the Division of Publications, with the result that the total number of employees reporting to its chief, who is the Editor of the Department, averages over 150, and the funds expended under the supervision of this officer amount, including the statutory roll, to $383,000.

A NOMINAL CHARGE FOR PUBLICATIONS.

Reasons have already been adduced in the first part of this report to show that it is impossible for the Editor to restrict the output of published matter. The law makes it quite as much the duty of this Department to diffuse as to acquire information of use to agriculture, and the principal means available to the Department for such diffusion is printing. Moreover, it is important to note the fact that as the work of the Department becomes better known and more widely appreciated the demand for its publications increases far more rapidly than the means to supply it. Great as the increase of the matter has been in the past two years, that is, with 10,000,000 copies of all publications to distribute, more applications for our publications are refused because the editions are exhausted than was the case years ago when the number of copies did not aggregate much more than a quarter as much. I have frequently called attention to this fact in connection with the demand for our publications and urged that some more businesslike and systematic method of distribution than that now in vogue be practiced. To supply every applicant with all he asked for would not only be wasteful, but it would involve an amount of printing which we can not imagine Congress being willing to pay for. In the absence of an entirely free list to which all our publications may be sent on request, there is no

more equitable mode of distribution conceivable than one which attaches a small charge sufficient to merely cover the paper, printing, and binding, the proceeds from which should be set aside to the credit of the Department for use exclusively in reprinting such publications as might still be called for.

FARMERS' BULLETINS.

The great increase in the number of Farmers' Bulletins allotted to the use of Members of Congress resulted in a Congressional distribution of these useful publications aggregating 4,289,126 copies out of a total of 6,150,000 copies. It has not been found necessary to increase the appropriation for this purpose this year, inasmuch as Senators and Representatives have drawn considerably less than the total amount allotted to them. The demand upon the Department for these publications is unceasing, but the proportion allowed the Secretary is restricted to one-fifth of the whole number, which is not at all adequate to meet the requests addressed directly to the Department. The same remark applies in even greater degree to the Yearbook, of which the Department receives no more than it did ten years ago of the old Annual Report, for which the Yearbook has been substituted.

UNNECESSARY ILLUSTRATIONS.

There is a growing tendency in nearly all the Bureaus, Divisions, and Offices toward extravagance in the number of illustrations in the bulletins submitted for publication. Objection is not made to illustrations of any kind which are absolutely necessary to convey information that can not well be imparted by words, but protest is made against the too frequent use of illustrations for the purpose of making the book attractive. This remark is particularly directed toward full-page plate illustrations, and still more especially to colored plates, the number of which should be restricted to absolute requirements, because of the expense involved, not only in the making of the plates, but in the separate printing and extra quality of paper and the insertion of the same in the publication. The more frequent use of text illustrations is earnestly recommended, because they are effective and inexpensive, and the Division is prepared to assist in making the necessary drawings and engravings.

This subject has now become sufficiently important to attract the attention of the President, who, on October 6 last, called the attention of the heads of Departments to the present tendency to increase the number and size of printed reports and documents and to include many unnecessary and expensive illustrations. The following order was subsequently (October 14) issued by the Secretary:

> The President has directed the attention of the heads of Departments to the present tendency to increase the number and size of printed reports and documents, expressing the belief that there is much useless matter and a large number of unnecessary and expensive illustrations included in many of the reports published, thus involving a great expense which accomplishes no practical good.
>
> I am strongly of the impression that as regards unnecessary illustrations there is in this Department an opportunity for reform in the line of the President's expressed wish. Your attention is therefore called to this matter with the earnest injunction that in the future you will rigidly exclude from the articles submitted by you for publication all unnecessary illustrations. By unnecessary, I mean all such as are not required to enable the reader to fully apprehend the meaning of the text.
>
> Please give this matter your careful consideration and attention.
>
> Respectfully,
>
> JAMES WILSON, *Secretary.*

CHARACTER OF THE DEPARTMENT PUBLICATIONS.

In this connection, it may be well to review briefly the nature of the publications of this Department in order to determine to what extent, if at all, efforts should be directed to diminishing their number or restricting their size. Unquestionably, the figures giving the total number of copies of all publications issued by this Department are enormous, in spite of which, however, it is very doubtful whether the Secretary could judiciously restrict their number or their size, except, perhaps, in the matter of illustrations. It must be borne in mind that the duty of the Department to diffuse the information it acquires is imposed upon it by law just as imperatively as its acquisition. It may reasonably be alleged that the existence in the Department of any information which either is or may be of value to agriculture imposes on the Secretary the duty of making it public. The time was, undoubtedly, when a very large number of the publications issued were printed in editions far too large, with a result that notwithstanding an injudiciously lavish distribution, enormous numbers of copies were left on hand. For many years, however, the efforts of this Division have been directed to restrict the size of the editions of the several publications issued. To this end the proposed distribution is agreed upon before publication and the number issued is made just sufficient to cover it and leave a few hundred copies of the work for miscellaneous demands. When necessity arises for a further supply, additional copies can be promptly printed from the plates which the Public Printer keeps on hand for a considerable time after publication, and this policy explains the large proportion of reprints, amounting last year to 317, representing 12,500 pages of printed matter. Under this system the editions of our publications, excluding, of course, the Yearbook, Farmers' Bulletins, and other publications which may be ordered by Congress, run from 1,000 to 5,000 copies, very rarely exceeding and usually much less than the latter figure, where ten years ago editions of from 10,000 to 15,000 copies were very common.

CONTINUED POPULARITY OF FARMERS' BULLETINS.

In numbers printed, the Farmers' Bulletins exceed all other publications, aggregating last year over 6,000,000 copies, and they no doubt have been very freely distributed, over 4,000,000 copies having been sent out by Senators, Representatives, and Delegates in Congress. On the whole, however, this may be said to be in the line of economy, as these bulletins are greatly restricted as to size; no plate illustrations are allowed in them, they are issued in the cheapest form, without cover, the cost rarely averaging over a cent and a half each, and they supply the popular demand, not only proving more satisfactory to the recipients, but saving the distribution of a large number of more expensive publications. While the Farmers' Bulletins thus represent as to the numbers printed and distributed more than one-half of the printing of this Department, they form a comparatively insignificant part of the editorial work and a very small part of the total expense. The 23 Farmers' Bulletins which passed through this Division last year, for instance, aggregated a little over 700 pages of matter, or about 4 per cent of the total amount of new matter edited in the Division. In the matter of expense, the total appropriation for the preparation and printing of Farmers' Bulletins was but $107,500, or about one-seventh of the total amount expended for the printing of Department publications.

EXPENDITURES FOR PRINTING AND BINDING.

The allotment for printing and binding for the Department of Agriculture for the year was $130,000, to which should be added a deficiency appropriation of $20,000, aggregating $150,000, of which sum $20,000 was for the use of the Weather Bureau, over which this office had no supervision. Of the remaining $130,000, the expenditures during the year were $128,194.71. This does not include the total expenditures for printing and binding, since various Bureaus, Divisions, and Offices have special funds to which printing may be charged, although there is no specific amount set aside for such purpose.

The total expenditures from the three funds from which printing may be defrayed—namely, the regular printing fund, the fund for Farmers' Bulletins, and the divisional funds—are set forth in the tables. These statements also show the amount expended for each Bureau, Division, and Office from the general printing fund and a summary of the expenditures under the several accounts of the Division of Publications for the year.

The total amount expended for printing and binding delivered to the Department from July 1, 1901, to June 30, 1902, inclusive, was $255,313.85. This, of course, does not include the publications specially ordered by Congress.

The total amount appropriated for the use of this Division for the current year, and including the pay of artists, the cost of labor and material in the distribution of documents, and the salaries of the editorial and clerical force, amounts to $383,820. To arrive at the total cost of the printing of the Department, however, there must be added thereto the cost of the Yearbook, of the annual reports of the Weather Bureau, Bureau of Animal Industry, Bureau of Soils, and of other publications specially ordered by Congress, amounting to considerably over $400,000 more. This does not include the special appropriation for the branch printing office of the Weather Bureau. Including the cost of handling and distributing the Department's publications through the mail, the total amount properly chargeable to the diffusion of useful information by this Department under the terms of the law will exceed $1,000,000 yearly. This is less than 20 per cent of the total appropriations for the Department, and it is somewhat interesting to recall the fact that for the first twenty years of the Department's existence the cost of printing was more than half of the whole expenditure, or, in other words, that the cost of distribution of information considerably exceeded the amount expended in its acquisition. Tables showing number and cost of the publications issued, expenditures from various funds, etc., are given elsewhere.

THE WORK OF THE BRANCH PRINTING OFFICE.

The work of this office has very greatly increased during the past year. Reference to the table, given elsewhere, shows that during the year 2,500 requisitions were drawn upon the branch printing office, an increase over the previous year of 25 per cent. This does not, however, fully represent the increase in the work, for the number of pieces handled for the fiscal year 1902, aggregating 22,715,904, is nearly 50 per cent more than the year previous. This great increase in the volume of work was necessarily handled with serious difficulty,

owing to the lack of suitable quarters and sufficient room, and the efficiency with which the work was done reflects great credit upon Mr. Frank Wallace, the foreman, and deserves acknowledgment. One of the most serious consequences resulting from inadequate quarters is the impossibility of increasing and perfecting the equipment of the office. The Public Printer has several times professed his entire willingness to give to this office an equipment sufficient to make it a model of its kind and to very greatly extend its facilities for work, provided suitable quarters were furnished.

In this respect the branch office shares in the many and great inconveniences suffered equally in the editorial department of our work and by the document section. The Division of Publications now occupies various portions of five different buildings, and in no one of these are the accommodations afforded to it ample as to room or adapted to the work it has to do. It is impossible to make reference to this matter without commending in the strongest terms the members of my force for the efficiency of their work and the cheerful patience with which it is performed under the most trying conditions.

INDEXING DEPARTMENT PUBLICATIONS.

I have frequently and strongly urged the necessity of undertaking in this office a complete index of all the department publications. The value of such an index is beyond question, and the need of it becomes greater each day. Heretofore the want of sufficient assistance has made such an undertaking impossible. For the current year, however, the appropriations provide for sufficient additional assistance to undertake the work, but unfortunately we now find ourselves so embarrassed for lack of room that it has been utterly impossible for me to take advantage of the liberality of Congress and obtain the appointment of the editorial clerk provided for, with whose assistance we had hoped to undertake this indexing work. It seems truly deplorable that urgently needed work should have to be abandoned, after suitable provision has been made therefor by Congress, owing to lack of space in which to carry it on.

THE YEARBOOK.

The first delivery of the Yearbook for 1901 was made June 27, 1902, and while the volume is somewhat larger than desired, it nevertheless has the merit of containing more and shorter articles than most of its predecessors. The distribution by the Department was somewhat delayed because the quotas of Senators, Representatives, and Delegates in Congress were delivered to them at the Capitol by the Public Printer in advance of the completion of the delivery of the allotment for the use of the Department. In this connection, I beg earnestly to renew the recommendation made in previous reports of this Division that the number of copies of the Yearbook printed for the use of the Department be increased to 50,000, as the present quota of 30,000 copies is inadequate to meet the actual requirements for distribution to correspondents and others to whom the Department is under special obligation. With the present allotment it is necessary to refer all miscellaneous applicants to Members of Congress.

REPRINTS OF "CATTLE BOOK" AND OF "HORSE BOOK."

The following joint resolutions were passed by the Fifty-seventh Congress (first session):

[PUBLIC RESOLUTION NO. 28.]

Joint resolution providing for the publication of 50,000 copies of the Special Report on the Diseases of Cattle.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That there be printed and bound in cloth 50,000 copies of the Special Report on the Diseases of Cattle, the same to be first revised and brought to date under the supervision of the Secretary of Agriculture, 30,000 for the use of the House of Representatives, 15,000 for the use of the Senate, and 5,000 for the use of the Department of Agriculture. Approved June 5, 1902.

[PUBLIC RESOLUTION NO. 33.]

Joint resolution providing for the publication of 200,000 copies of the Special Report on the Diseases of the Horse.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That there be printed and bound in cloth 200,000 copies of the Special Report on the Diseases of the Horse, the same to be first revised and brought up to date under the supervision of the Secretary of Agriculture, 128,000 copies for the use of the House of Representatives, 64,000 copies for the use of the Senate, and 8,000 copies for the use of the Department of Agriculture. Approved June 24, 1902.

It will be observed that provision is made for the revision of each of the reports with a view to bringing the same up to date, and this revision is now in progress in the Bureau of Animal Industry. Owing to the magnitude of the work, considerable time will be required to complete it. In this connection it is interesting to note that 370,000 copies of the Report on Diseases of the Horse and 130,000 copies of the Special Report on Diseases of Cattle and on Cattle Feeding have heretofore been printed by authority of Congress, the distribution of which has been controlled by Senators, Representatives, and Delegates.

PHOTOGRAPHIC WORK.

Special reference should be made to the increasing amount of photographic work done by this Division for the various Bureaus, Divisions, and Offices of the Department, a summary of which for the year is as follows:

Photographs on wood	44
Prints retouched	91
Prints mounted	134
Films and negatives developed	174
Prints made from negatives	418
Blue and black prints	467

So extensive has become this branch of the work that enlarged quarters are urgently needed, without which the usefulness of the Division along the lines mentioned can not be further extended. This work was done by Mr. Louis S. Williams, who also engraved on wood during the year 25 illustrations of various sizes and kinds.

HOW PUBLICATIONS ARE DISTRIBUTED.

There is an occasional tendency to disregard the order of the Secretary relating to the distribution of publications. Under the said order all mailing of documents was intrusted to the Division of Publications, including that of publications sent out upon the order of the chief of the Bureau, Division, or Office from which the same emanated. The intention was to concentrate all the actual mailing work in the Division of Publications, where an adequate force is maintained for the purpose. Nevertheless, certain Divisions continue occasionally to do mailing in violation of the order mentioned. Fearing that the method of distribution may not be fully understood, it is deemed advisable to explain the same.

When the manuscript of a bulletin is submitted for publication, it should be accompanied by a card showing the plan of distribution. The only part of this scheme in which the Bureau, Division, or Office is interested is the number of copies needed for its mailing list, including copies to be sent abroad. This office fills in the other blanks, including those necessary for libraries, legations, etc., which, by the Secretary's order, receive all publications issued by the Department. The author is always supplied with 100 copies, and 100 copies are furnished to the Bureau, Division, or Office for use in correspondence or distribution to visitors. A small reserve is kept for supplying miscellaneous applicants, and when copies are desired for such purpose an order should be made on the Division of Publications, using the blank prepared therefor. For use in correspondence, as already stated, where it is convenient to mark a paragraph or page in a bulletin and send with the letter, a limited supply may be furnished the Bureau, Division, or Office of issue, but the indiscriminate mailing of such allotment of publications in response to miscellaneous requests should not occur. All such requests should be referred to this office.

THE DOCUMENT SECTION.

The work of caring for and distributing the publications of the Department of Agriculture devolves upon the document section and entails an amount of clerical, semiclerical, and manual work unsuspected by those not familiar with its details.

During the fiscal year ended June 30, 1902, Farmers' Bulletins to the number of 6,199,426 were received from the Public Printer, and 5,530,010 were distributed, 4,289,126 of which were forwarded at the request of Senators, Representatives, and Delegates. Of miscellaneous publications, other than Farmers' Bulletins, 3,138,828 copies were received from the Public Printer and 2,714,661 different documents were mailed from the document section. In addition to the 9,244,671 franks necessary for mailing these documents, the bookkeeping, the keeping of card-index lists, the preparing of 31,000 registry cards, the making of 138,833 orders, and the preparing and sending out of 97,382 notification blanks make a heavy demand upon the clerical force provided for this work.

As all the Department's mail in relation to the distribution of its documents receives attention in the document section, the correspondence work devolving upon the assistant in charge consumes no little part of his time, as will be readily understood when it is known that 16,729 letters were written during the year.

RECOMMENDATIONS.

It seems to me impossible to carefully peruse this cursory review of the work of this Division with any appreciation of the responsibility that editorial work involves, without realizing that the principal assistants upon whom I am bound to depend in carrying on the work of the Division are not adequately remunerated, either by comparison with assistants charged with notably responsible duties in this and in other Departments, or by comparison with persons discharging similar duties in private business enterprises. The fact that manuscript, represented, when printed, by over 18,000 pages of new matter, was all carefully gone over by myself and my assistants, read and reread, questions of modification or elimination discussed with the several chiefs or with the authors themselves, and the entire matter carefully prepared for the compositor, so as to facilitate the passage of the work through the office of the Public Printer, will impress any experienced publisher or editor with the great extent of the work done, and no one should be better able than the Secretary himself to appreciate the responsibility of those who are charged with seeing that nothing gets into print save what meets his approval.

While so much may be said for the editorial work, it must not be forgotten that the administration of the very large sum of $400,000, and its equitable adjustment to the needs of all the Bureaus and several Divisions contributing to the publication work of the Department, involves considerable judgment and care.

Finally, it may be remembered that the control of 150 persons, of whom about 120 are in the immediate charge of the assistant who has charge of the document section, involves considerable responsibility, calling for the exercise of both judgment and tact. Indeed, it may be said for all the responsible officers of this Division that in addition to more than ordinary intelligence and education, experience in publication work, good sense, and tact are essentially requisite. I submit that for all these qualifications salaries of from $1,600 to $2,000 are not adequate. The associate editor of this Division, who is also the assistant chief of the Division, should, in my opinion, receive $2,400 at least, in place of the $2,000 he is now getting. The two assistant editors and the assistant in charge of the document section, who are receiving $1,800 per annum each, should be promoted to $2,000, and the three assistant editors now receiving $1,600 should be promoted to $1,800. I feel satisfied that if these recommendations should meet with your approval the more closely the committees having our interests in charge in Congress may investigate the matter the more surely will they be satisfied that the recommendations made are just.

STATISTICS OF PUBLICATION WORK.

The details of the publication work are given in the following tables:

Number and classes of publications issued in the fiscal year 1902.

Publications—	
Chargeable to regular fund	365
Chargeable to divisional funds	39
Chargeable to Farmers' Bulletin fund	259
Printed as Executive documents	9
Edited at Weather Bureau	85
Total	757

Number of publications, original and reprint, and number of pages and copies of each class, fiscal years 1900, 1901, and 1902.

Character of publication.	1900.			1901.			1902.		
	Number of publications.	Pages.	Copies.	Number of publications.	Pages.	Copies.	Number of publications.	Pages.	Copies.
Original	225	10,852	4,338,978	262	14,656	3,903,094	355	18,184	4,009,136
Reprint	148	5,983	2,004,500	232	9,139	3,115,600	317	12,454	5,791,040
Weather Bureau	95	1,164	809,000	112	3,341	880,587	85	664	786,404
Total	468	17,999	7,152,478	606	27,136	7,899,281	757	31,302	10,586,580

Number of publications issued from 1893 to 1902, by years.

Years.	Number of publications.	Total number of copies.
1893	210	2,689,084
1894	205	3,169,310
1895	254	4,100,660
1896	376	6,561,700
1897	424	6,541,210
1898	501	6,280,365
1899	603	7,075,975
1900	468	7,152,428
1901	606	7,899,281
1902	757	10,586,580
Total	4,404	62,056,593

Number of publications, original and reprint, and pages, by Bureaus, Divisions, and Offices, fiscal year 1902.

Bureaus, Divisions, and Offices.	Publications.			Pages.			Number of copies.		
	Original.	Reprint.	Total.	Original.	Reprint.	Total.	Original.	Reprint.	Total.
Secretary's Office	6	6	12	429	305	734	119,000	82,000	201,000
Executive documents	7	2	9	3,037	563	3,600	554,100	10,500	564,600
Accounts and Disbursements	1		1	18		18	200		200
Animal Industry	37	43	80	1,360	1,268	2,628	293,736	1,010,440	1,304,176
Biological Survey	14	5	19	634	203	837	43,100	67,500	110,600
Chemistry	16	9	25	541	331	872	52,700	157,500	210,200
Entomology	26	23	49	958	948	1,906	144,300	427,500	571,800
Experiment Stations	92	101	193	4,646	3,694	8,340	252,100	2,058,000	2,310,100
Foreign Markets	6	10	16	517	967	1,484	21,500	15,000	36,500
Forestry	9	14	23	198	941	1,139	75,200	144,500	219,700
Library	6		6	515		515	4,950		4,950
Plant Industry	56	60	116	3,542	1,848	5,390	328,200	1,152,000	1,480,200
Publications	20	12	32	263	432	695	824,250	287,500	1,111,750
Public Road Inquiries	7	17	24	194	403	597	31,000	190,100	221,100
Soils	24	9	33	741	338	1,079	47,600	141,500	189,100
Statistics	23	4	27	535	161	696	1,211,600	7,000	1,218,600
Weather Bureau	90	2	92	720	52	772	792,004	40,000	832,004
Total	440	317	757	18,848	12,454	31,302	4,795,540	5,791,040	10,586,580

Amount expended for the various Bureaus, Divisions, and Offices for printing and binding, 1902.

Division of Accounts	$1,422.66
Bureau of Animal Industry	5,125.03
Division of Biological Survey	3,054.57
Bureau of Chemistry	3,532.85
Division of Entomology	3,030.12
Office of Experiment Stations	16,544.43
Section of Foreign Markets	5,208.14
Bureau of Forestry	11,703.89
Library	6,100.06
Bureau of Plant Industry	21,050.36
Division of Publications	1,098.76
Office of Public Road Inquiries	2,435.24
Bureau of Soils	9,404.80
Division of Statistics	12,689.12
Miscellaneous	3,101.84
Printing at branch printing office for the various Bureaus, Divisions, and Offices	22,692.84
Total	128,194.71

Farmers' Bulletins issued, 1889–1902, by years.

Originals and reprints of Farmers' Bulletins.	Number of bulletins.	Number of copies.
Fiscal year 1902:		
Originals	23	575,000
Reprints	236	5,575,000
Total	259	6,150,000
Fiscal year 1901:		
Originals	14	415,000
Reprints	157	2,930,000
Total	171	3,345,000
Fiscal year 1900:		
Originals	18	525,000
Reprints	90	1,835,000
Total	108	2,360,000
Fiscal year 1899:		
Originals	22	520,000
Reprints	154	1,917,000
Total	176	2,437,000

Cost of printing Farmers' Bulletins, 1900–1902.

Item.	Number of bulletins.	Number of copies.	Cost.
Fiscal year 1902:			
Paid from Farmers' Bulletin fund	259	6,150,000	$107,363.05
Fiscal year 1901:			
Paid from Farmers' Bulletin fund	171	3,345,000	51,796.68
Fiscal year 1900:			
Paid from Farmers' Bulletin fund	97	2,150,000	30,665.15
Paid from general printing fund	11	210,000	3,469.69
Total	108	2,360,000	34,134.84

New Farmers' Bulletins issued during the fiscal year 1902.

Number of bulletin.	Title of bulletin.	Total number of copies.
133	Experiment Station Work—XVIII	10,000
134	Tree Planting on Rural School Grounds	10,000
135	Sorghum Sirup Manufacture	10,000
136	Earth Roads	10,000
137	The Angora Goat	10,000
138	Irrigation in Field and Garden	10,000
139	Emmer: A Grain for the Semiarid Regions	30,000
140	Pineapple Growing	30,000
141	Poultry Raising on the Farm	30,000
142	Principles of Nutrition and Nutritive Value of Food	40,000
143	Conformation of Beef and Dairy Cattle	30,000
144	Experiment Station Work—XIX	30,000
145	Carbon Bisulphid as an Insecticide	30,000
146	Insecticides and Fungicides: Chemical Composition and Effectiveness of Certain Preparations	20,000
147	Winter Forage Crops for the South	30,000
148	Celery Culture	30,000
149	Experiment Station Work—XX	30,000
150	Clearing New Land	30,000
151	Dairying in the South	30,000
152	Scabies in Cattle	35,000
153	Orchard Enemies in the Pacific Northwest	30,000
154	The Home Fruit Garden	30,000
155	How Insects Affect Health in Rural Districts	30,000
	Total	575,000

Farmers' Bulletins contributed by Bureaus, Divisions, and Offices, 1902.

Bureaus, Divisions, and Offices.	New.	Reprints.	Number of copies.
Secretary's Office		4	80,000
Bureau of Animal Industry	5	38	1,115,000
Division of Biological Survey		3	65,000
Bureau of Chemistry	2	6	185,000
Division of Entomology	3	19	510,000
Office of Experiment Stations	5	89	2,170,000
Bureau of Forestry	1	3	100,000
Bureau of Plant Industry	5	51	1,290,000
Division of Publications	1	11	315,000
Office of Public Road Inquiries	1	4	140,000
Bureau of Soils		6	140,000
Weather Bureau		2	40,000
Total	23	236	6,150,000

Number of copies of Farmers' Bulletins issued (Nos. 1 to 155) and number distributed to Members of Congress, 1894–1902.

Date.	Total number of copies issued.	Congressional distribution.
Prior to 1894	540,000	
In 1894	278,500	
In 1895	1,567,000	885,770
In 1896	1,891,000	1,316,695
In 1897	2,387,000	1,967,237
In 1898	2,170,000	1,580,065
In 1899	2,437,000	1,101,985
In 1900	2,360,000	1,666,909
In 1901	3,345,000	2,195,010
In 1902	6,150,000	4,289,126
Total	23,125,500	15,002,797

New Farmers' Bulletins issued each year from 1895 to 1902, inclusive.

Year.	Number of bulletins.
In 1895	11
In 1896	13
In 1897	16
In 1898	21
In 1899	22
In 1900	18
In 1901	14
In 1902	23
Total	138

Appropriations for the fiscal years 1902 and 1903.

Appropriations.	1902.	1903.
Statutory roll	$25,020	$28,820
General printing fund	[a] 110,000	[a] 155,000
General printing fund, deficiency	20,000	----------
Preparation and printing of Farmers' Bulletins	107,500	107,500
Artists, laborers, and material fund	63,000	----------
Artists, laborers, and material fund, deficiency	15,000	----------
Rent of building and alterations	2,500	----------
Additional assistants, artists, draftsmen, etc	----------	12,500
Labor, material, wagon, horses, rent of building, etc	----------	80,000
Total	343,020	383,820

[a] Exclusive of $20,000 for the Weather Bureau.

Expenditures under general appropriations for fiscal year ended June 30, 1902.

General printing fund	$128,194.71
Preparation and printing of Farmers' Bulletins	107,363.05
Artists, laborers, and material fund [a]	72,480.36
Rent of building and alterations	2,454.60
Total	310,492.72

Expenditures for printing and binding, total and by funds, 1902.

TOTAL EXPENDITURES.

Divisional publications paid from general fund	$92,435.34
Divisional publications paid from special funds	27,746.06
Blank books, blank forms, etc., paid from general fund	13,066.53
Blank books, blank forms, etc., paid from special funds	556.30
Branch office (all work) paid from general fund	22,692.84
Farmers' Bulletins paid from Farmers' Bulletin fund	98,816.78
Total	255,313.85

EXPENDITURES BY FUNDS.

General printing fund ($130,000, exclusive of $20,000 for Weather Bureau):		
Expended for the various Bureaus, Divisions, and Offices	$105,501.87	
Expended for printing at branch office for the various Bureaus, Divisions, and Offices	22,692.84	
		$128,194.71

[a] Of this appropriation, the sum of $5,500, which was made immediately available, was used in paying for labor, material, etc., for fiscal year ended June 30, 1901.

Farmers' Bulletin fund		$98,816.78
Divisional funds:		
Bureau of Animal Industry	$4,567.67	
Division of Biological Survey	919.78	
Division of Entomology	153.12	
Office of Experiment Stations	8,841.06	
Office of Foreign Markets	2,385.18	
Bureau of Forestry	9,838.28	
Bureau of Plant Industry	952.76	
Division of Statistics	644.51	
		28,302.36
Total		255,313.85

Expenditures from special fund of the Division.

Expenditures during the year from the special appropriation for this Division, $63,000,[a] and deficiency appropriation $15,000; for artists and preparation of illustrations, for artists' supplies, and for labor and materials in distribution of documents:	
Illustrating, including pay of artists	$5,846.07
Labor in distribution of documents	59,303.94
Materials for document section	6,663.44
Artists' supplies	666.91
Total	72,480.36
From fund for preparation and printing of Farmers' Bulletins:	
Preparation of Farmers' Bulletins	8,546.27
Printing Farmers' Bulletins	98,816.78
Total	107,363.05
From fund for rent and alteration of building:-	
Rent, wages, and material	2,454.60
Grand total	182,298.01

Requisitions on the main office by Bureaus, Divisions, Offices, etc., 1902.

Secretary's Office	5
Division of Accounts and Disbursements	43
Bureau of Animal Industry	134
Division of Biological Survey	22
Bureau of Chemistry	32
Division of Entomology	42
Office of Experiment Stations	239
Section of Foreign Markets	26
Bureau of Forestry	89
Library	39
Bureau of Plant Industry	163
Division of Publications	33
Office of Public Road Inquiries	31
Bureau of Soils	70
Division of Statistics	27
Weather Bureau	4
Miscellaneous	15
Total	1,014

[a] Of this amount the sum of $5,500 was made immediately available and was used in payments for labor, material, etc., for the fiscal year ended June 30, 1901. For the current year the appropriation is divided—$12,500 being for additional assistants, artists, draftsmen, and purchase of manuscripts, and $80,000 for labor and material in the distribution of documents, including purchase of horses, wagons, harness, rent of buildings, etc.

Publications printed in the branch printing office, 1902.

Bureaus, Divisions, and Offices.	Requisitions.	Number of copies printed.
Secretary's Office	3	2,000
Bureau of Animal Industry	7	33,000
Division of Biological Survey	6	7,100
Bureau of Chemistry	5	6,000
Division of Entomology	10	33,000
Office of Experiment Stations	4	8,000
Bureau of Forestry	1	10,000
Bureau of Plant Industry	3	35,000
Division of Publications	17	792,000
Office of Public Road Inquiries	6	40,000
Bureau of Soils	1	3,500
Division of Statistics	4	11,100
Total	67	980,700

Total work done in the branch printing office, 1902.

Envelopes	1,862,600
Letter heads and note heads	968,544
Cards	2,023,751
Circulars	384,675
Blanks	4,002,280
Labels and shipping tags	1,311,628
Franks	9,889,450
Monthly and other lists	821,518
Crop Reporter	[a]1,000
Circular letters and other notices	452,965
Miscellaneous	997,493
Total	22,715,904
Number of requisitions, 1902	2,500
Number of requisitions, 1901	2,092
Number of pieces of work, 1901	15,267,472

Requisitions on the branch office by Bureaus, Divisions, Offices, etc., 1902.

Secretary's Office	3
Division of Accounts and Disbursements	45
Bureau of Animal Industry	233
Division of Biological Survey	68
Bureau of Chemistry	129
Division of Entomology	68
Office of Experiment Stations	169
Section of Foreign Markets	18
Bureau of Forestry	125
Library	45
Bureau of Plant Industry	766
Division of Publications	188
Office of Public Road Inquiries	53
Bureau of Soils	73
Division of Statistics	296
Appointment Clerk	130
Miscellaneous	91
Total	2,500
Canceled	50

[a] Extra copies. All the composition of 12 editions of Crop Reporter, 8 pages each, was done in the branch printing office.

Illustration work, 1902.

Drawings, retouching photographs, photographing on wood, etc., made by the artists in the Division of Publications	2,933
Wood engravings	25
Requests for duplicate electrotypes	223
Duplicate electrotypes furnished to correspondents on request	1,330
Requisitions and authorizations	116
Illustrations printed or published (not including reprints)	2,648

Number and cost of illustrations by Bureaus, Divisions, and Offices, 1901.

Bureaus, Divisions, and Offices.	Illustrations.	Cost of illustrations.	Amount chargeable to divisional funds.	Amount chargeable to Division of Publications' illustration fund.
Bureau of Animal Industry	33	$136.23	$134.43	$1.80
Division of Biological Survey	15	31.52	31.02	.50
Bureau of Chemistry	7	16.64		16.64
Division of Entomology	9	21.48	21.48	
Office of Experiment Stations	1	.75		.75
Bureau of Forestry	12	13.31	9.75	3.56
Bureau of Plant Industry	75	379.10	346.37	32.73
Division of Publications	187	144.00		144.00
Office of Public Road Inquiries	32	61.30	61.30	
Bureau of Soils	29	54.53	51.44	3.09
Total	400	858.86	655.79	203.07
Artists' supplies		666.91		666.91
Artists' salaries		5,643.00		5,643.00
Total	400	7,168.77	655.79	6,512.98

Number of publications sold by the Superintendent of Documents and amount received, 1898–1902.

Department.	Copies of publications sold.					Amount received.				
	1902.	1901.	1900.	1899.	1898.	1902.	1901.	1900.	1899.	1898.
Department of Agriculture	25,279	24,127	16,905	18,750	17,740	$3,551.91	$3,220.25	$2,157.65	$2,154.45	$2,089.15
All other Departments	9,932	9,458	10,998	8,058	3,623	7,394.30	6,862.44	6,744.56	5,401.66	2,448.12
Total	35,211	33,585	27,903	26,808	21,363	10,946.21	10,082.69	8,902.21	7,556.11	4,537.27

APPENDIX A.

PUBLICATIONS ISSUED DURING THE YEAR ENDED JUNE 30, 1902.

[The following publications were issued during the year ended June 30, 1902. Those to which a price is attached, with the exception of publications of the Weather Bureau, must be obtained of the Superintendent of Documents, Union Building, Washington, D. C., to whom are turned over all copies not needed for official use, in compliance with section 67 of the act providing for the public printing and binding and the distribution of public documents. Remittances should be made to him by postal money order. Weather Bureau publications to which a price is attached must be obtained from the chief of that Bureau. Applications for those that are for free distribution should be made to the Secretary of Agriculture, Washington, D. C.]

OFFICE OF THE SECRETARY.

	Copies.
Progress of the Beet-Sugar Industry in the United States in 1900. By Charles F. Saylor, Special Agent, and H. W. Wiley, Chemist, U. S. Department of Agriculture. Pp. 178. Report No. 69. July, 1901. Price, 10 cents	1,000
Reprint, January, 1902	1,000
Sewage Disposal on the Farm, and the Protection of Drinking Water. By Theobald Smith, M. D., Professor in Harvard University, Pathologist to the Massachusetts State Board of Health, etc. Pp. 20, figs. 8. Farmers' Bulletin No. 43. (Reprint.) August, 1901	10,000
Reprint, November, 1901	20,000
Exhaustion and Abandonment of Soils. Testimony of Milton Whitney, Chief of Division of Soils, before the Industrial Commission. Pp. 48. Report No. 70. October, 1901. Price, 5 cents	68,000
Marketing Farm Produce. By George G. Hill, formerly Manager and Editor of the American Farmer, Illinois. Pp. 28, figs. 7. Farmers' Bulletin No. 62. (Reprint.) October, 1901	20,000
Reprint, March, 1902	30,000
Report of the Secretary of Agriculture, 1901. Pp. 113. November, 1901	45,000
Some Mutual Relations Between Alkali Soils and Vegetation. By Thomas H. Kearney, Assistant Physiologist, Division of Vegetable Physiology and Pathology, and Frank K. Cameron, Soil Chemist, Division of Soils. Pp. 78. Report No. 71. February, 1902. Price, 5 cents	3,000
Seventeenth Annual Report of the Bureau of Animal Industry for the Year 1900. Pp. 642, pls. 98, figs. 238. Cloth. March, 1902. Price, 85 cents	30,000
Report of the Appointment Clerk. By J. B. Bennett. Pp. 5. May, 1902	500
Revised edition, May, 1902	1,500
Cultivation of Cigar-Leaf Tobacco in Florida. By Marcus L. Floyd, of the Division of Soils, in cooperation with the Division of Vegetable Physiology and Pathology. Pp. 31, pls. 8, figs. 6. Report No. 62. (Reprint.) May, 1902. Price, 5 cents	1,000
Statistics of Oleomargarine, Oleo Oil, and Filled Cheese, 1900 and 1901. Pp. 22. (Senate Doc. No. 168, 57th Cong., 1st sess.) February, 1902	500
Annual Report of the Office of Experiment Stations for the Year Ended June 30, 1901. Pp. 489, pls. 41. (House Doc. No. 334, 57th Cong., 1st sess.) May, 1902	1,800
Progress of the Beet-Sugar Industry in the United States in 1901. Pp. 106, pls. 17, figs. 5. (Senate Doc. No. 316, 57th Cong., 1st sess.) May, 1902	1,800
Yearbook of the U. S. Department of Agriculture, 1901. Pp. 846, frontispiece, pls. 90, figs. 52. Price, 80 cents. June, 1902	500,000

CONGRESSIONAL.

Annual Reports of the Department of Agriculture for the Fiscal Year Ended June 30, 1901. Pp. cxv, 344. Report of the Secretary of Agriculture. Departmental Reports. January, 1902	3,000

Copies.

Field Operations of the Division of Soils, 1900. By Milton Whitney, Chief. With accompanying papers by Thomas H. Means, Frank D. Gardner, Clarence W. Dorsey, Jay A. Bonsteel, J. Garnett Holmes, Frank K. Cameron, Lyman J. Briggs, Marcus L. Floyd, William G. Smith. Pp. 473, pls. 51, figs. 47, maps 24. Cloth. (Second Report.) February, 1902. Price, $1.80 17,000

Report upon the Forestry Investigations of the U. S. Department of Agriculture. 1877–1898. By B. E. Fernow, formerly Chief of the U. S. Department of Agriculture. (Prepared in accordance with a provision in the act making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1899.) Pp. 401, pls. 32, figs. 105. (House Doc. No. 181, 55th Cong., 3d sess.) (Reprint.) February, 1902 500

Progress of the Beet-Sugar Industry in the United States in 1898. Pp. 162. Part I, by Charles F. Saylor, Special Agent. Part II, by H. W. Wiley, Chemist of the U. S. Department of Agriculture. (Reprint.) February, 1902 10,000

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

Report of the Chief of the Division of Accounts and Disbursements for 1901. By F. L. Evans. Pp. iii, 253–269. (From Annual Reports, Department of Agriculture.) January, 1902 200

BUREAU OF ANIMAL INDUSTRY.

American Breeds of Fowls. I.—The Plymouth Rock. By T. F. McGrew. Pp. 32, pls. 6, colored; figs. 10. Bulletin No. 29. July, 1901. Price 15 cents 10,000
Reprint, October, 1901 4,440

Dairy Products at the Paris Exposition of 1900. By Henry E. Alvord, Chief of the Dairy Division, Bureau of Animal Industry. Pp. ii, 599–626, pls. 5. (Reprint from Yearbook of Department of Agriculture for 1900.) July, 1901 1,000

Standard Varieties of Chickens. By George E. Howard, Secretary of National Poultry and Pigeon Association. Under the supervision of Dr. D. E. Salmon, Chief of Bureau of Animal Industry. Pp. 44, figs. 42. Farmers' Bulletin No. 51. Revised. (Reprint.) July, 1901 10,000
Reprint, October, 1901 10,000
Reprint, November, 1901 40,000
Reprint, March, 1902 30,000
Reprint, May, 1902 30,000
Reprint, June, 1902 20,000

Ducks and Geese: Standard Breeds and Management. By George E. Howard, Secretary of National Poultry and Pigeon Association. Pp. 48, figs. 37. Farmers' Bulletin No. 64. (Reprint.) July, 1901 10,000
Reprint, November, 1901 40,000
Reprint, May, 1902 30,000

Hog Raising in the South. By S. M. Tracy, M. S., formerly Director of the Mississippi Agricultural Experiment Station. Pp. 40. Farmers' Bulletin No. 100. (Reprint.) July, 1901 10,000
Reprint, October, 1901 35,000
Reprint, June, 1902 15,000

Blackleg: Its Nature, Cause, and Prevention. By Victor A. Nörgaard, Chief of Pathological Division. Pp. 23, fig. 1. Circular No. 31. Revised. (Reprint.) August, 1901 5,000
Reprint, June, 1902 10,000

Treatment for Roundworms in Sheep, Goats, and Cattle. By D. E. Salmon, D. V. M., Chief of Bureau of Animal Industry. Pp. 8. Circular No. 35. August, 1901 3,000
Reprint, November, 1901 1,000

Hog Cholera and Swine Plague. By D. E. Salmon, D. V. M., Chief of the Bureau of Animal Industry. Pp. 16. Farmers' Bulletin No. 24. (Reprint.) August, 1901 10,000
Reprint, October, 1901 30,000
Reprint, December, 1901 10,000
Reprint, March, 1902 30,000

Copies.

The Dairy Herd: Its Formation and Management. By Henry E. Alvord, C. E., Chief Dairy Division, Bureau of Animal Industry. Reprinted, with revision by the author, from the Yearbook of the U. S. Department of Agriculture for 1894. Pp. 24. Farmers' Bulletin No. 55. (Reprint.)
August, 1901 10,000
Reprint, December, 1901 35,000
Reprint, April, 1902 30,000

Raising Sheep for Mutton. By Charles F. Curtiss, Director of the Iowa Agricultural Experiment Station. Pp. 48, figs. 18. Farmers' Bulletin No. 96. (Reprint.) August, 1901 10,000
Reprint, December, 1901 40,000
Reprint, March, 1902 30,000

The Angora Goat. By George Fayette Thompson, Editorial Clerk, Bureau of Animal Industry. Pp. 48, figs. 7. Farmers' Bulletin No. 137. September, 1901 10,000
Reprint, October, 1901 30,000
Reprint, March, 1902 30,000

American Breeds of Fowls—II. The Wyandotte. By T. F. McGrew. Pp. 30, pls. 10, colored; figs. 3. Bulletin No. 31. October, 1901. Price, 15 cents 10,000

The Tuberculin Test of Imported Cattle. By D. E. Salmon, D. V. M., Chief of Bureau of Animal Industry. Pp. 22. Bulletin No. 32. October, 1901. Price, 5 cents 20,000

Directions for the use of Blackleg Vaccine. By Victor A. Nörgaard, Chief of Pathological Division. Pp. 8. Circular No. 23. Second revision, October, 1901 10,000
Reprint, April, 1902 10,000

The Free Distribution of Blackleg Vaccine. By Victor A. Nörgaard, V. S. (Copenhagen), Chief of Pathological Division, Bureau of Animal Industry. Pp. iii, 35–51. (Reprint from the Seventeenth Annual Report of the Bureau of Animal Industry, 1900.) October, 1901 3,500

Meats and Meat Products at the Paris Exposition of 1900. By Henry E. Alvord, C. E., Chief of the Dairy Division, Bureau of Animal Industry, in charge of the United States Animal Industry Exhibit at Paris. Pp. 223–234. (Reprinted from the Seventeenth Annual Report of the Bureau of Animal Industry.) October, 1901 1,500

The Thirteenth International Medical Congress. The Tenth International Congress of Hygiene and Demography. By E. A. de Schweinitz, Ph. D., M. D., Chief of Biochemic Division, Bureau of Animal Industry. Pp. 254–261. (Reprinted from the Seventeenth Annual Report of Animal Industry, 1900.) October, 1901 300

The Bacillus of Tuberculosis. By E. A. de Schweinitz, Ph. D., Chief of Biochemic Division, Bureau of Animal Industry. Pp. iii, 262–280. (Reprinted from the Seventeenth Annual Report of the Bureau of Animal Industry, 1900.) October, 1901 300

Poultry Raising on the Farm. By D. E. Salmon, Chief of the Bureau of Animal Industry. Pp. 16, figs. 31. Farmers' Bulletin No. 141. October, 1901 30,000
Reprint, December, 1901 25,000
Reprint, March, 1902 30,000
Reprint, May, 1902 30,000
Reprint, June, 1902 30,000

Relation of Bovine Tuberculosis to the Public Health. By D. E. Salmon, D. V. M., Chief of Bureau of Animal Industry. (Read as chairman of the Committee on Animal Diseases and Animal Food of the American Public Health Association at Buffalo, N. Y., September 16, 1901.) Pp. 36. Bulletin No. 33. November, 1901. Price, 5 cents 20,000

Breeds of Dairy Cattle. By Henry E. Alvord, C. E., Chief of Dairy Division, Bureau of Animal Industry. (Reprinted from the Report of the Bureau of Animal Industry for 1898.) Pp. 48, figs. 21. Farmers' Bulletin No. 106. (Reprint.) November, 1901 30,000
Reprint, April, 1902 30,000

Copies.

Trichinosis in Germany. Part I. General Remarks on Trichinosis in Germany. By Ch. Wardell Stiles, Ph. D. Part II. A Statistical Review of Trichinosis in Germany During the Eighteen Years 1881–1898. By Ch. Wardell Stiles. Ph. D. Part III. European Cases of Trichinosis of Alleged American Origin. By Ch. Wardell Stiles, Ph. D. Part IV. Bibliography of Trichinosis in Germany. By Albert Hassall, M. R. C. V. S. Pp. 211. Bulletin No. 30. December, 1901. Price, 15 cents 1,000

Plant Poisoning of Stock in Montana. By E. V. Wilcox, Ph. D., Office of Experiment Stations. Pp. iii, 91–121, pls. 13, figs. 2. (Reprint from the Seventeenth Annual Report of the Bureau of Animal Industry, 1900.) December, 1901 1,000

Butter Making on the Farm. By C. P. Goodrich, Dairy Instructor, Farmers' Institute Department, University of Wisconsin. Under supervision of the Dairy Division, Bureau of Animal Industry. Pp. 16, Farmers' Bulletin No. 57. (Reprint.) December, 1901 35,000
Reprint, May, 1902 30,000

Care of Milk on the Farm. By R. A. Pearson, B. S., Assistant Chief of Dairy Division, Bureau of Animal Industry. Pp. 40, figs. 9. Farmers' Bulletin No. 63. (Reprint.) December, 1901 35,000
Reprint, May, 1902 30,000

Some Essentials in Beef Production. By Charles F. Curtiss, Director of the Iowa Agricultural Experiment Station. Pp. 24, figs. 17. Farmers' Bulletin No. 71. (Reprint.) December, 1901 30,000

Report of the Chief of the Bureau of Animal Industry for 1901. By D. E. Salmon. Pp. iii, 15–42. (From Annual Reports, Department of Agriculture.) January, 1902 1,200

Facts About Milk. By R. A. Pearson, B. S., Assistant Chief, Dairy Division, Bureau of Animal Industry. Pp. 29, figs. 8. Farmers' Bulletin No. 42. (Reprint.) January, 1902 30,000
Reprint, June, 1902 20,000

Rabies: Its Cause, Frequency, and Treatment. By D. E. Salmon, D. V. M., Chief of the Bureau of Animal Industry. Pp. 211–246. (Reprinted from Yearbook of Department of Agriculture for 1900.) February, 1902 1,000

Market Milk: A Plan for Its Improvement. By R. A. Pearson, M. S., Assistant Chief of Dairy Division. Pp. iii, 158, 193, pls. 10. (Reprinted from the Seventeenth Annual Report of the Bureau of Animal Industry, 1900.) February, 1902 8,000

Dairy Products at the Paris Exposition of 1900. By Henry E. Alvord, Chief of the Dairy Division, Bureau of Animal Industry, in charge of the United States Animal Industry Exhibit at Paris. Pp. iii, 194–222. (Reprinted from the Seventeenth Annual Report of the Bureau of Animal Industry, 1900.) February, 1902 12,000

Verminous Diseases of Cattle, Sheep, and Goats in Texas. By Ch. Wardell Stiles, Ph. D., Zoologist of Bureau of Animal Industry. Pp. iii, 356–379. (Reprint from Seventeenth Annual Report of Bureau of Animal Industry, 1900.) February, 1902 2,000

Conformation of Beef and Dairy Cattle. By Andrew M. Soule, Professor of Agriculture, and Vice-Director of Tennessee Agricultural Experiment Station. Pp. 44, figs. 49. Farmers' Bulletin No. 143. February, 1902 30,000
Reprint, May, 1902 20,000

Apoplectiform Septicæmia in Chickens. Preliminary Report on a Highly Fatal Disease caused by a Nonpyogenic Streptococcus. By Victor A. Nörgaard, V. S. (Copenhagen), Chief of Pathological Division, Bureau of Animal Industry, and John R. Mohler, V. M. D., Acting Assistant Chief of Pathological Division of Bureau of Animal Industry. Pp. 24, pls. 4. Bulletin No. 36. March, 1902. Price, 10 cents 6,936

Market Classes of Horses. By George M. Rommel, B. S. A., Expert in Animal Husbandry, Bureau of Animal Industry. Pp. 32, pls. 11. Bulletin No. 37. March, 1902. Price, 15 cents 10,000

Description and Treatment of Scabies in Cattle. By Richard W. Hickman, V. M. D., Chief of Miscellaneous Division, Bureau of Animal Industry. Pp. 23, frontispiece, figs. 16. Bulletin No. 40. March, 1902. Price, 5 cents 4,000

Copies.

State Standard for Dairy Products, 1902. By Henry E. Alvord, Chief of Dairy Division. Pp. 3. Circular No. 25. Revised edition. March, 1902 1,000

American Breeds of Beef Cattle, with Remarks on Pedigrees. By George M. Rommel, B. S. A., Expert in Animal Industry. Pp. 34, pls. 23. Bulletin No. 34. April, 1902. Price, 15 cents 9,000

Eleven Miscellaneous Papers on Animal Parasites. Pp. 61, pls. 5, figs. 38. Bulletin No. 35. April, 1902. Price, 10 cents 2,000

Officials, Associations, and Educational Institutions Connected with the Dairy Interests of the United States for the Year 1902. By Henry E. Alvord, Chief of Dairy Division. Pp. 8. Circular No. 36. April, 1902 5,000

Index-Catalogue of Medical and Veterinary Zoology. Part I. [Authors A to Azevedo.] By Ch. Wardell Stiles, Ph. D., and Albert Hassall, M. R. C. V. S. Pp. 46. Bulletin No. 39. May, 1902. Price, 5 cents 3,000

Mexico as a Market for Pure-bred Beef Cattle from the United States. By D. E. Salmon, D. V. M., Chief of Bureau of Animal Industry. Pp. 28, frontispiece. Bulletin No. 41. May, 1902. Price, 10 cents 6,000

Preliminary Report on Argentina as a Market for Pure-bred Cattle from the United States. Pp. 4. Circular No. 37. May, 1902 3,000

Mohair and Mohair Manufactures. By George Fayette Thompson, Editorial Clerk, Bureau of Animal Industry. Pp. ii, 271–284, pls. 2, colored, fig. 1. (Reprint from Yearbook of Department of Agriculture for 1901.) May, 1902 100

The Tuberculin Test for Tuberculosis. By D. E. Salmon, D. V. M., Chief of the Bureau of Animal Industry. Pp. iii, 581–592. (Reprint from Yearbook of Department of Agriculture for 1902.) May, 1902 1,000

Emergency Report on Surra. By D. E. Salmon, D. V. M., Chief of Bureau of Animal Industry, and Ch. Wardell Stiles, Ph. D., Pathologist of Bureau of Animal Industry. With a Bibliography of Surra and allied Trypanosomatic Diseases. By Albert Hassall, M. R. C. V. S., Acting Assistant Zoologist of Bureau of Animal Industry. Pp. 152, pls. 16, figs. 112. Bulletin No. 42. June, 1902. Price, 15 cents 2,000

Cattle Ticks (*Ixodoidea*) of the United States. By D. E. Salmon, D. V. M., Chief of Bureau of Animal Industry, and Ch. Wardell Stiles, Ph. D., Zoologist of Bureau of Animal Industry. Pp. iii, 380–491, figs. 95, (Reprinted from the Seventeenth Annual Report of the Bureau of Animal Industry [1900].) June, 1902 1,000

Dairying in the South. By S. M. Tracy, M. S., formerly Director of the Mississippi Agricultural Experiment Station. Pp. 48, figs. 4. Farmers' Bulletin No. 151. June, 1902 30,000

Scabies in Cattle. By Richard W. Hickman, V. M. D., Chief of Miscellaneous Division, Bureau of Animal Industry. Pp. 24, figs. 16. Farmers' Bulletin No. 152. June, 1902 35,000

DIVISION OF BIOLOGICAL SURVEY.

How Birds Affect the Orchard. By F. E. L. Beal, B. S., Assistant, Biologist, Biological Survey. Pp. ii, 291–304. (Reprint from Yearbook of Department of Agriculture for 1900.) July, 1901 5,000

The Food of Nestling Birds. By Sylvester D. Judd, Ph. D., Assistant, Biological Survey. Pp. iii, 411–436. (Reprint from Yearbook of Department of Agriculture for 1900.) July, 1901 5,000

North American Fauna No. 20. Revision of the Skunks of the Genus Chincha. By Arthur H. Howell, Assistant, Biological Survey. Prepared under the direction of Dr. C. Hart Merriam, Chief of Division of Biological Survey. Pp. 62, pls. 8, August, 1901. Price, 10 cents 3,000

Some Common Birds in Their Relation to Agriculture. By F. E. L. Beal, B. S., Assistant Ornithologist, Biological Survey. Pp. 40, figs. 22. Farmers' Bulletin No. 54. (Reprint.) August, 1901 10,000
Reprint, December, 1901 35,000
Reprint, May, 1902 20,000

Digest of Game Laws for 1901. By T. S. Palmer and H. W. Olds, Assistants, Biological Survey. Prepared under the direction of Dr. C. Hart Merriam, Chief of Biological Survey. Pp. 152. Bulletin No. 16. September, 1901. Price, 10 cents 5,000

Copies.

North American Fauna No. 21. Natural History of the Queen Charlotte Islands, British Columbia, and Natural History of the Cook Inlet Region, Alaska. By Wilfred H. Osgood, Assistant, Biological Survey. Prepared under the direction of Dr. C. Hart Merriam, Chief of Division of Biological Survey. Pp. 87, pls. 7, fig. 1. September, 1901. Price, 10 cents 3,000

Food of the Bobolink, Blackbirds, and Grackles. By F. E. L. Beal, B. S., Assistant Biologist. Prepared under the direction of Dr. C. Hart Merriam, Chief of Biological Survey. Pp. 77, pl. 1, figs. 6. Bulletin No. 13. (Reprint.) October, 1901. Price, 5 cents 2,000

The Relation of Sparrows to Agriculture. By Sylvester D. Judd, Ph. D., Assistant, Biological Survey. Prepared under the direction of Dr. C. Hart Merriam, Chief of Biological Survey. Pp. 98, pls. 4, figs. 19. Bulletin No. 15. October, 1901. Price, 10 cents 5,000

Laws for the Protection of Birds and Game in the District of Columbia. By T. S. Palmer, Assistant Chief of Biological Survey. Pp. 8. Circular No. 34. October, 1901 2,500

Report of the Acting Chief of the Biological Survey for 1901. By T. S. Palmer. Pp. iii, 151–162. (From Annual Reports, Department of Agriculture.) January, 1902 500

Directions for the Destruction of Prairie Dogs. By C. Hart Merriam, Chief, Biological Survey. Pp. 2. Circular No. 32. Revised edition. February, 1902 2,000

Legislation for the Protection of Birds. By T. S. Palmer, Assistant Chief, Biological Survey. Pp. 143. Bulletin No. 12. Revised edition. March, 1902. Price, 10 cents 1,500

Directory of State Officials and Organizations Concerned with the Protection of Birds and Game, 1902. By T. S. Palmer, Assistant Chief, Biological Survey. Pp. 10. Circular No. 35. April, 1902 1,000

Importation of Reptiles into Hawaii. P. 1. Circular 36. May, 1902 600

Protection and Importation of Birds under act of Congress approved May 25, 1900. Pp. 6. Circular No. 29. (Reprint.) June, 1902 500

Regulations for the Importation of Eggs of Game Birds for Propagation. Pp. 2. Circular No. 37. June, 1902 1,000

Two Vanishing Game Birds: The Woodcock and the Wood Duck. By A. K. Fisher, Ornithologist, Biological Survey. Pp. iv, 447–458, pls. 2, figs. 3. (Reprinted from Yearbook of Department of Agriculture for 1901.) June, 1902 8,000

BUREAU OF CHEMISTRY.

Exhibit of the Bureau of Chemistry at the Pan-American Exposition, Buffalo, N. Y., 1901. Prepared under the direction of Harvey W. Wiley, Chief of Bureau, by E. E. Ewell, W. D. Bigelow, and Logan Waller Page. Pp. 29, pls. 4. Bulletin No. 63. August, 1901. Price, 5 cents 3,500

The Selection of Materials for Macadam Roads. By Logan Waller Page, Expert in Charge of Road Material Laboratory, Division of Chemistry. Pp. iii, 349–356. (Reprinted from the Yearbook of the U. S. Department of Agriculture for 1900.) August, 1901 3,000

The Use and Abuse of Food Preservatives. By W. D. Bigelow, Assistant in Charge of Food Investigations, Division of Chemistry. Pp. ii, 551–568. (Reprint from Yearbook of Department of Agriculture for 1900.) August, 1901 3,000

Sorghum Sirup Manufacture. By A. A. Denton, Medicine Lodge, Kans. Pp. 40, figs. 26. Farmers' Bulletin No. 135. September, 1901 10,000
Reprint, October, 1901 30,000
Reprint, May, 1902 30,000

Composition of Maize (Indian Corn), Including the Grain, Meal, Stalks, Pith, Fodder, and Cobs. Compiled chiefly from the Records of the Division of Chemistry, by H. W. Wiley, Chemist of the Department of Agriculture. Pp. 31. Bulletin No. 50. (Reprint.) October, 1901. Price, 5 cents 1,000

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Report of Irrigation Investigations in California, under the direction of Elwood Mead, assisted by William E. Smythe, Marsden Manson, J. M. Wilson, Charles D. Marx, Frank Soulé, C. E. Grunsky, Edward M. Boggs, and James D. Schuyler. Pp. 411, pls. 29, figs. 16. Quarto. Cloth. Bulletin No. 100. December, 1901. Price, $1.25; paper, 90 cents 1,000

Irrigation in the United States. Testimony of Elwood Mead, Irrigation Expert in Charge, before the United States Industrial Commission, June 11 and 12, 1901. Pp. 47, pls. 12, fig. 1. Bulletin No. 105. (Reprinted from Report of United States Industrial Commission on Agriculture and Agricultural Labor.) December, 1901. Price, 15 cents 1,000
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Proceedings of the Sixth Annual Meeting of the American Asssociation of Farmers' Institute Workers, Held at Buffalo, New York, September 18 and 19, 1901. Edited by A. C. True and D. J. Crosby for the Office of Experiment Stations, and G. C. Creelman for the Association. Pp. 55. Bulletin No. 110. March, 1902. Price, 5 cents 5,000

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Irrigation Laws of the Northwest Territories of Canada and of Wyoming, with Discussions by J. S. Dennis, Deputy Commissioner of Public Works, Canada, and Fred Bond, State Engineer of Wyoming, and J. M. Wilson, Agent and Expert, Irrigation Investigations, Office of Experiment Stations. Pp. 90, frontispiece, pls. 5. Bulletin No. 96. (Reprint.) June, 1902. Price, 10 cents 500

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Pineapple Growing. By Peter H. Rolfs, Pathologist, in charge of Tropical Laboratory, Vegetable Pathological and Physiological Investigations, Bureau of Plant Industry. Pp. 48, figs. 4. Farmers' Bulletin No. 140. October, 1901 30,000

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Range Improvement in Arizona. (Cooperative Experiments with the Arizona Experiment Station.) By David Griffiths, Expert, in Charge of Field Management, Grass and Forage Plant Investigations. Pp. 31, pls. 6, figs. 5. Bulletin No. 4. January, 1902. Price, 10 cents 5,000

Seeds and Plants Imported through the Section of Seed and Plant Introduction for Distribution in Cooperation with the Agricultural Experiment Stations. Inventory No. 9, Nos. 4351–5500. Pp. 79. Bulletin No. 5. January, 1902. Price, 10 cents 500
Reprint, June, 1902 500

Report of the Chief of the Bureau of Plant Industry for 1901. By B. T. Galloway. Pp. iii, 43–94. (From Annual Reports, Department of Agriculture.) January, 1902 1,000

A List of American Varieties of Peppers. By W. W. Tracy, jr., Assistant, Botanical Investigations and Experiments. Pp. 19. Bulletin No. 6. February, 1902. Price, 10 cents 2,500

A Collection of Economic Fungi Prepared for Distribution. By Flora W. Patterson, Mycologist, Vegetable Pathological and Physiological Investigations. Pp. 31. Bulletin No. 8. February, 1902. Price, 10 cents 2,009

The North American Species of Spartina. By Elmer D. Merrill, Assistant Agrostologist, Grass and Forage Plant Investigations. Pp. 16. Bulletin No. 9. February, 1902. Price, 10 cents 2,000

Records of Seed Distribution and Cooperative Experiments with Grasses and Forage Plants. By F. Lamson-Scribner, Agrostologist, Grass and Forage Plant Investigations. Pp. 23. Bulletin No. 10. February, 1902. Price, 10 cents 3,000

Johnson Grass: Report of Investigations made During the Season of 1901. By Carleton R. Ball, Assistant Agrostologist, Grass and Forage Plant Investigations. Pp. 24, pl. 1, fig. 1. Bulletin No. 11. February, 1902. Price, 10 cents 5,000

The Decay of Timber and Methods of Preventing It. By Hermann von Schrenk, Instructor in Henry Shaw School of Botany, and Special Agent in Charge of Mississippi Valley Laboratory, Vegetable Pathological and Physiological Investigations. Pp. 96, pls. 18, figs. 27. Bulletin No. 14. March, 1902. Price, 55 cents 3,000

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Winter Forage Crops for the South. By Carelton R. Ball, Assistant Agrostologist, Grass and Forage Plant Investigations. Bureau of Plant Industry. Pp. 36, figs. 24. Farmers' Bulletin No. 147. March, 1902. 30,000
Reprint, June, 1902 15,000

The Algerian Durum Wheats: A Classified List, with Descriptions. By Carl S. Scofield, Expert, Botanical Investigations and Experiments. Pp. 48, pls. 8. Bulletin No. 7. April, 1902. Price, 15 cents 2,500

Experiments in Range Improvement in Central Texas. By H. L. Bently, Special Agent, Grass and Forage Plant Investigations. Pp. 72, pls. 2, figs. 6. Bulletin No. 13. April, 1902. Price, 10 cents 2,500

Forage Conditions on the Northern Border of the Great Basin, Being a Report upon Investigations made During July and August, 1901, in the Region Between Winnemucca, Nevada, and Ontario, Oregon. By David Griffiths, Expert, in Charge of Field Management, Grass and Forage Plant Investigations. Pp. 60, pls. 16. Bulletin No. 15. April, 1902. Price, 15 cents 2,500

Some Diseases of the Cowpea. I. The Wilt Disease of the Cowpea and Its Control. By W. A. Orton, Assistant Pathologist. II. A Cowpea Resistant to Root Knot (*Heterodera radicicola*). By Herbert J. Webber, Physiologist, and W. A. Orton, Assistant Pathologist. Pp. 38, pls. 6, fig. 1. Bulletin No. 17. April, 1902. Price, 10 cents 5,000

Kentucky Blue Grass Seed: Harvesting, Curing, and Cleaning. By A. J. Pieters, Botanist in Charge of Seed Laboratory, and Edgar Brown, Assistant Botanist, Botanical Investigations and Experiments. Pp. 19, pls. 6, figs. 3. Bulletin No. 19. April, 1902. Price, 10 cents 3,000

Celery Culture. By W. R. Beattie, In Charge of Testing Gardens, Office of Botanical Investigations and Experiments. Pp. 32, figs. 7. Farmers' Bulletin No. 148. April, 1902 30,000
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Observations on the Mosaic Disease of Tobacco. By Albert F. Woods, Pathologist and Physiologist, Vegetable Pathological and Physiological Investigations. Pp. 24, pls. 6. Bulletin No. 18. May, 1902. Price, 15 cents 3,000

The Seeds of Rescue Grass and Chess. By F. H. Hillman, Assistant, Seed Laboratory, Botanical Investigations and Experiments. Pp. 4. Bulletin No. 25. Advance sheets of pp. 1–4. May, 1902 25,000

Stock Ranges of Northwestern California: Notes on the Grasses and Forage Plants and Range Conditions. By Joseph Burtt Davy, Assistant Botanist, Agricultural Experiment Station, University of California. Prepared under the direction of the Agrostologist, Grass and Forage Plant Investigations. Pp. 81, pls. 8, maps 3, figs. 4. Bulletin No. 12. June, 1902. Price, 15 cents 2,500

A Preliminary Study of the Germination of the Spores of Agaricus Campestris and other Basidiomycetous Fungi. By Margaret C. Ferguson, cooperating with Vegetable Pathological and Physiological Investigations. Pp. 43, pls. 3. Bulletin No. 16. June, 1902. Price, 10 cents 2,500

The Relation of Nutrition to the Health of Plants. By Albert F. Woods, Pathologist and Physiologist, Bureau of Plant Industry. Pp. ii, 155–176. (Reprint from Yearbook of Department of Agriculture for 1901.) June, 1902 1,000

Progress in Plant and Animal Breeding. By Willet M. Hays, M. Agr., Agriculturist, Minnesota, Agricultural Experiment Station. Pp. ii, 217–232. (Reprint from Yearbook of Department of Agriculture for 1901.) June, 1902 1,000

Agricultural Seeds—Where Grown and How Handled. By A. J. Pieters, Botanist, in Charge of Seed Laboratory, Bureau of Plant Industry. Pp. iv, 233–256, pls. 4, figs. 2. (Reprint from Yearbook of Department of Agriculture for 1901.) June, 1902 500

Agriculture in the Tropical Islands of the United States. By O. F. Cook, Botanist, in Charge of Investigations in Tropical Agriculture, Bureau of Plant Industry. Pp. iv, 349–368, pls. 6. (Reprint from Yearbook of Department of Agriculture for 1901.) June, 1902 700

The Home Fruit Garden. By L. C. Corbett, Horticulturist, Bureau of Plant Industry. Pp. ii, 431–446, figs. 6. (Reprint from Yearbook of Department of Agriculture for 1901.) June, 1902 3,000

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Commercial Apple Orcharding. By G. B. Brackett, Pomologist, Bureau of Plant Industry. Pp. ii, 593–608, pls. 4. (Reprint from Yearbook of Department of Agriculture for 1901.) June, 1902 2,000

The Home Fruit Garden: Preparation and Care. By L. C. Corbett, Horticulturist, Bureau of Plant Industry. Pp. 20, figs. 6. Farmers' Bulletin No. 154. June, 1902 30,000

Botanical Investigations and Experiments.

Contributions from the U. S. National Herbarium, Vol. VI, Plant Life of Alabama. An account of the Distribution, Modes of Association, and Adaptations of the Flora of Alabama, Together with a Systematic Catalogue of the Plants Growing in the State. Prepared in cooperation with the Geological Survey of Alabama by Charles Mohr, Ph. D. Pp. 921, pls. 13. July, 1901. Price, 50 cents 1,000

Commercial Plant Introduction. By Jared G. Smith, Chief of Section of Seed and Plant Introduction. Pp. ii, 131–144. (Reprint from Yearbook of Department of Agriculture for 1900.) July, 1901 5,000

Some Poisonous Plants of the Northern Stock Ranges. By V. K. Chesnut, in Charge of Poisonous Plant Investigations, Division of Botany. Pp. iii, 305–324, pls. 3, figs. 4. (Reprint from Yearbook of Department of Agriculture for 1900.) July, 1901 3,000

Testing Commercial Varieties of Vegetables. By W. W. Tracy, jr., Assistant, Division of Botany. Pp. iii, 543–550. (Reprint from Yearbook of Department of Agriculture for 1900.) July, 1901 2,000

The Date Palm and its Culture. By Walter T. Swingle, Agricultural Explorer, Section of Seed and Plant Introduction. Pp. v, 453–490, pls. 9, figs. 7. (Reprint from Yearbook of Department of Agriculture for 1900.) August, 1901 3,000

Weeds; And How to Kill Them. By Lyster H. Dewey, Assistant Botanist. Pp. 32, figs. 10. Farmers' Bulletin No. 28. (Reprint.) August, 1901 10,000
Reprint, October, 1901 35,000

Contributions from the U. S. National Herbarium. Vol. VII, No. 2. The Origin and Distribution of the Cocoa Palm. By O. F. Cook. Pp. v, 257–293. September, 1901. Price, 5 cents 2,500

American Ginseng: Its Commercial History, Protection, and Cultivation. By George V. Nash. Revised and extended by Maurice G. Kains. Pp. 32, figs. 5. Bulletin No. 16. Revised edition. (Reprint.) October, 1901. Price, 5 cents 500
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Seeds of Commercial Saltbushes. By G. N. Collins. Pp. 28, pls. 8. Bulletin No. 27. October, 1901. Price, 15 cents 5,000

The Chayote: A Tropical Vegetable. By O. F. Cook, Special Agent for Tropical Agriculture. Pp. 31, pls. 8. Bulletin No. 28, Division of Botany. October, 1901. Price, 10 cents 4,000

Rice Culture in the United States. By Dr. S. A. Knapp. Pp. 28. Farmers' Bulletin No. 110. (Reprint.) November, 1901 20,000

Red Clover Seed: Information for Purchasers. By A. J. Pieters, Assistant Botanist, Division of Botany, In Charge of Pure Seed Investigations. Pp. 11, figs. 2. Farmers' Bulletin No. 123. (Reprint.) October, 1901. 20,000
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The Seed Coats of Certain Species of the Genus Brassica. By A. J. Pieters and Vera K. Charles. Pp. 19, figs. 6. Bulletin No. 29. November, 1901. Price, 5 cents 5,000

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Flax for Seed and Fiber in the United States. By Charles Richards Dodge, Special Agent for Fiber Investigations. Pp. 16. Farmers' Bulletin No. 27. (Reprint.) November, 1901 20,000

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The Stock-Poisoning Plants of Montana: A Preliminary Report. By V. K. Chesnut and E. V. Wilcox. Pp. 150, pls. 36. Bulletin No. 26. (Reprint.) December, 1901. Price, 25 cents 500

Thirty Poisonous Plants of the United States. By V. K. Chesnut, Assistant Botanist, U. S. Department of Agriculture. Pp. 32, figs. 24. Farmers' Bulletin No. 86. (Reprint.) December, 1901 20,000

Hop Growing in California. By Daniel Flint. Pp. 28, figs. 2. Farmers' Bulletin No. 115. (Reprint.) December, 1901 20,000

Contributions from the U. S. National Herbarium. Vol. VII, No. 3. Plants used by the Indians of Mendocino County, Cal. By V. K. Chesnut. Pp. vi, 295–408, vii, pls. x–xxi, figs. 66–78. January, 1902. Price, 15 cents 1,000

Grass and Forage Plant Investigations.

List of the Publications of the Division of Agrostology. By F. Lamson-Scribner, Agrostologist. Pp. 8. Circular No. 36. July, 1901 4,000

Economic Grasses. By F. Lamson-Scribner, Agrostologist. Pp. 85, pls. 3, figs. 91. Bulletin No. 14. Revised. (Reprint.) August, 1901. Price, 10 cents 1,000

Our Native Pasture Plants. By F. Lamson-Scribner, Agrostologist. Pp. ii, 581–598, pls. 4, figs. 11. (Reprint from Yearbook of Department of Agriculture for 1900.) August, 1900 2,000

Cattle Ranges of the Southwest: A History of the Exhaustion of the Pasturage and Suggestions for Its Restoration. By H. L. Bently, Special Agent in Charge of Grass Station at Abilene, Tex. Pp. 32, figs. 9. Farmers' Bulletin No. 72. (Reprint.) August, 1901 10,000
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Millets. By Thomas A. Williams, Assistant Agrostologist. Pp. 28, figs. 6. Farmers' Bulletin No. 101. (Reprint.) August, 1901 10,000
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Southern Forage Plants. Compiled from the publications of the Division of Agrostology by F. Lamson-Scribner, Agrostologist. Pp. 48, figs. 14. Farmers' Bulletin No. 102. (Reprint.) August, 1901 10,000
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Field Work of the Division of Agrostology: A Review and Summary of the Work Done since the Organization of the Division July 1, 1895. By Cornelius L. Shear, Assistant Agrostologist. Prepared under the direction of F. Lamson-Scribner, Agrostologist. Pp. 67, maps 8, pls. 28. Bulletin No. 25. September, 1901. Price, 15 cents 3,000

Alfalfa or Lucern. By Jared G. Smith, Assistant Agrostologist. Pp. 24, figs. 3. Farmers' Bulletin No. 31. (Reprint.) September, 1901 15,000
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The Soy Bean as a Forage Crop. By Thomas A. Williams, Assistant Agrostologist. Prepared under the direction of the Agrostologist. With an Appendix on Soy Beans as Food for Man. By C. F. Langworthy, Ph. D., Office of Experiment Stations. Pp. 24, figs. 4. Farmers' Bulletin No. 58. (Reprint.) November, 1901 40,000

Meadows and Pastures: Formation and Cultivation in the Middle Eastern States. By Jared G. Smith, Assistant Agrostologist. Pp. 28, figs. 9. Farmers' Bulletin No. 66. Revised edition. (Reprint.) November, 1901 30,000
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Cowpeas. By Jared G. Smith, Assistant Agrostologist. Pp. 16, fig. 1. Farmers' Bulletin No. 89. (Reprint.) November, 1901 40,000
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The Influence of Refrigeration on the Fruit Industry. By William A. Taylor, Assistant Pomologist. Pp. iii, 561–580, pls. 5. (Reprinted from Yearbook of U. S. Department of Agriculture for 1900.) August, 1901 .. 4,000
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The Fig: Its History, Culture, and Curing, with a Descriptive Catalogue of the Known Varieties of Figs. By Gustav Eisen, Ph. D. Pp. 317, pls. 15, figs. 93. Bulletin No. 9. February, 1902. Price, 35 cents 1,000

Vegetable Pathological and Physiological Investigations.

A New Wheat Industry for the Semiarid West. By Mark Alfred Carleton, Cerealist. Pp. 8. Circular No. 18. July, 1901 5,000
Successful Wheat Growing in Semiarid Districts. By Mark Alfred Carleton, Cerealist, Division of Vegetable Physiology and Pathology. Pp. ii, 529–542. (Reprinted from Yearbook of Department of Agriculture for 1900.) July, 1900 5,000
Spraying for Fruit Diseases. By B. T. Galloway, Chief of Divison of Vegetable Physiology and Pathology. Pp. 12, figs. 6. Farmers' Bulletin No. 38. (Reprint.) July, 1901 10,000
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The Cultural Characters of Pseudomonas Hyacinthi, Ps. Campestris, Ps. Phaseoli, and Ps. Stewarti—Four One-Flagellate Yellow Bacteria Parasitic on Plants. By Erwin F. Smith, Pathologist, in Charge of Laboratory of Plant Pathology. Pp. 153, fig. 1. Bulletin No. 28. August, 1901. Price, 10 cents 1,000
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Fungous Diseases of Forest Trees. By Hermann von Schrenk, Instructor in the Shaw School of Botany, and Special Agent in the Division of Vegetable Physiology and Pathology, Department of Agriculture. Pp. iii, 199–210, pls. 5. (Reprinted from Yearbook of U. S. Department of Agriculture for 1900.) August, 1901 5,000
Commercial Pear Culture. By M. B. Waite, Assistant Chief, Division of Vegetable Physiology and Pathology. Pp. iii, 369–396, pls. 3. (Reprint from Yearbook of Department of Agriculture for 1900.) August, 1901 .. 5,000
How to Grow Mushrooms. By William Falconer, under the Supervision of the Division of Vegetable Physiology and Pathology. Pp. 20, figs. 14. Farmers' Bulletin No. 53. (Reprint.) August, 1901 10,000
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Plant Breeding. By Willet M. Hays, Professor of Agriculture, University of Minnesota. Pp. 72, pls. 6, figs. 21. Bulletin No. 29. September, 1901. Price, 10 cents 5,000
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The Grain Smuts: How They are Caused and How to Prevent Them. By Walter T. Swingle, Special Agent, Division of Vegetable Physiology and Pathology. Pp. 20, figs. 8. Farmers' Bulletin No. 75. (Reprint.) November, 1901 25,000
Potato Diseases and Their Treatment. By B. T. Galloway, Chief of the Division of Vegetable Physiology and Pathology. Pp. 12, figs. 4. Farmers' Bulletin No. 91. (Reprint.) December, 1901 40,000
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Grape Diseases on the Pacific Coast. By Newton B. Pierce, Division of Vegetable Physiology and Pathology. Pp. 15, figs. 3. Farmers' Bulletin No. 30. (Reprint.) January, 1902	15,000
Peach Growing for Market. By Erwin F. Smith, Division of Vegetable Physiology and Pathology. Pp. 24, figs. 21. Farmers' Bulletin No. 33. (Reprint.) February, 1902	20,000
Methods of Propagating the Orange and Other Citrus Fruits. By Herbert J. Webber, Assistant, Division of Vegetable Physiology and Pathology, U. S. Department of Agriculture. Pp. ii, 471–489, figs. 13. (Reprinted with revision from the Yearbook of the Department of Agriculture for 1896. (Reprint.) April, 1902	5,000
The Bermuda Lily Disease: A Preliminary Report of Investigations. By Albert F. Woods, Assistant Chief, Division of Vegetable Physiology and Pathology. Pp. 15, figs. 4. Bulletin No. 14. (Reprint.) June, 1902. Price, 5 cents	1,000

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Publications of the U. S. Department of Agriculture for sale by the Superintendent of Documents, Union Building, Washington, D. C. Corrected to August 1, 1901. Pp. 40. (No. 179.) Eighth edition. August, 1901	10,000
Free Delivery of Rural Mails. By Charles H. Greathouse, M. A., Editorial Clerk, Division of Publications. Pp. iii, 513–528, pls. 4, figs. 2. (Reprint from Yearbook of U. S. Department of Agriculture for 1900.) August, 1901	1,000
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List of Bulletins and Circulars Issued by the U. S. Department of Agriculture and Available for Free Distribution. Corrected to January 1, 1902. Pp. 24. No. 247. Seventh edition. March, 1902	10,000
Sheep, Hogs, and Horses in the Pacific Northwest. I. Sheep Husbandry, by James Withycombe, V. S., Director of the Oregon Experiment Station; II. Hog Raising, by Hiram T. French, M. S., Agriculturist of the Idaho Experiment Station; III. The Horse Industry, by S. B. Nelson, D. V. M., Professor of Veterinary Science in the Washington Agricultural College. Pp. 28, figs. 2. Farmers' Bulletin No. 117. (Reprint.) March, 1902	30,000
Clearing New Land. By Franklin Williams, jr., Farmer and Horticulturist, Fairfax County, Va. Pp. 24, figs. 7. Farmers' Bulletin No. 150. May, 1902	30,000
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OFFICE OF PUBLIC ROAD INQUIRIES.

Mountain Roads. By James W. Abbott, Special Agent in Office of Public Road Inquiries for Western Division. Pp. iii, 183–198. (Reprint from Yearbook of Department of Agriculture for 1900.) July, 1901 — 3,000

Proceedings of the International Good Roads Congress, held at Buffalo, N. Y., September 16 to 21, 1901. Pp. 100. Bulletin No. 21. December, 1901. Price, 5 cents — 10,000

Reprint, May, 1902 — 10,000

Good Roads for Farmers. By Maurice O. Eldridge, Acting Director, Office of Public Road Inquiries. Pp. 47, figs. 49. Farmers' Bulletin No. 95. (Reprint.) December, 1901 — 40,000

Reprint, April, 1902 — 30,000

List of National, State, and Local Road Associations and Kindred Organizations in the United States. By Martin Dodge, Director. Pp. 13. Circular No. 36. January, 1902 — 500

Reprint, March, 1902 — 600

Report of the Office of Public Road Inquiries for 1901. By Martin Dodge, Director. Pp. iii, 235–252. January, 1902 — 500

Reprint, February, 1902 — 500

Earth Roads. By Maurice O. Eldridge, Assistant Director, Public Road Inquiries. Pp. 24, figs. 20. Farmers' Bulletin No. 136. February, 1902 — 10,000

Reprint, March, 1902 — 30,000

Reprint, June, 1902 — 30,000

Repairs of Macadam Roads. By E. G. Harrison, C. E. Pp. 14. Circular No. 30. March, 1902 — 10,000

Money Value of Good Roads to Farmers. By W. C. Latta, Purdue University, Lafayette, Ind. Pp. 4. Circular No. 23. (Reprint.) April, 1902 — 10,000

Reprint, June, 1902 — 5,000

Earth Roads: Hints on Their Construction and Repair. Compiled by Roy Stone, Special Agent in Charge of Road Inquiry. Pp. 20, figs. 11. Bulletin No. 8. (Reprint.) June, 1902. Price, 5 cents — 1,000

State Aid to Road Building in New Jersey. By Edward Burrough, Chairman of the New Jersey State Board of Agriculture and State Commissioner of Public Roads. Pp. 20. Bulletin No. 9. (Reprint.) June, 1902 — 5,000

Wide Tires. Laws of Certain States Relating to Their Use, and Other Information. Compiled by Roy Stone, Special Agent in Charge of Road Inquiry. Pp. 16. Bulletin No. 12. (Reprint.) June, 1902. Price, 5 cents — 5,000

Notes on the Employment of Convicts in Connection with Road Building. Compiled by Roy Stone, Director. Pp. 21, pls. 4. Bulletin No. 16, Revised. (Reprint.) June, 1902. Price, 5 cents — 5,000

Going in Debt for Good Roads. (Address delivered by Judge Thayer, of Clinton, before the Iowa Bankers' Association at their Annual Meeting in Council Bluffs, May 24, 1893.) Pp. 6. Circular No. 26. (Reprint.) June, 1902 — 5,000

Cost of Hauling Farm Products to Market or to Shipping Points in European Countries. By Roy Stone, Director of Road Inquiry. Pp. 12. Circular No. 27. June, 1902 — 1,000

Office of Road Inquiry. By Roy Stone, Director of Office of Road Inquiry. Object-Lesson Roads. By Roy Stone, Director of Office of Road Inquiry. Pp. 175–180, 373–382, pls. 2, fig. 1. (Reprint from Yearbook of Department of Agriculture for 1897.) June, 1902 — 2,000

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Road Building with Convict Labor in the Southern States. By J. A. Holmes, Special Agent in Office of Public Road Inquiries for Southern Division. Pp. 319–332, pls. 5. (Reprint from Yearbook of Department of Agriculture for 1901.) June, 1902 5,000

Government Cooperation in Object-Lesson Road Work. By Martin Dodge, Director of the Office of Public Road Inquiries. Pp. ii, 409–414, pls. 2. (Reprint from Yearbook of Department of Agriculture for 1901.) June, 1902 2,000

BUREAU OF SOILS.

Solution Studies of Salts Occurring in Alkali Soils. By Frank K. Cameron, Lyman J. Briggs, and Atherton Seidell. Pp. 89, figs. 10. Bulletin No. 18. August, 1901. Price, 5 cents 2,500

The World's Exhibit of Leaf Tobacco at the Paris Exposition of 1900. By Marcus L. Floyd, Tobacco Expert, Division of Soils. Pp. ii, 157–166, pls. 2. (Reprint from Yearbook of Department of Agriculture for 1900.) August, 1901 4,000

Objects and Methods of Investigating Certain Physical Properties of Soils. By Lyman J. Briggs, Assistant Chief and Physicist, Division of Soils. Pp. ii, 397–410, pls. 2, figs. 2. (Reprint from Yearbook of Department of Agriculture for 1900.) August, 1901 1,000

Catalogue of the First Four Thousand Samples in the Soil Collection of the Division of Soils. By Milton Whitney, Chief of Division of Soils. Pp. 145. Bulletin No. 16. (Reprint.) September, 1901. Price, 10 cents 500

Reclamation of Salt Marsh Lands. By Thos. H. Means, Assistant. Pp. 10. Circular No. 8. September, 1901 3,500

Tobacco Soils. By Milton Whitney, Chief of Division of Soils. Pp. 23. Farmers' Bulletin No 83. (Reprint.) October, 1901 20,000

General Review of the Work of the Division of Soils. By Milton Whitney, Chief of Division. Pp. iii, 19–60. (Reprinted from the Report on Field Operations of the Division of Soils for 1900.) November, 1901 500

Investigations on the Physical Properties of Soils. By Lyman J. Briggs. Pp. ii, 413–421. (Reprinted from the Report on Field Operations of the Division of Soils for 1900.) November, 1901 500

Farm Drainage. By C. G. Elliott, C. E., Member of the American Society of Civil Engineers, Peoria, Ill. Pp. 24, figs. 6. Farmers' Bulletin No. 40. (Reprint.) November, 1901 30,000

Methods of Curing Tobacco. By Milton Whitney, Chief of Division of Soils. Pp. 16. Farmers' Bulletin No. 60. Revised edition. (Reprint.) November, 1901 20,000

Reprint, November, 1902 20,000

The Culture of Tobacco. By Otto Carl Butterweck. Pp. 24. Farmers' Bulletin No. 82. (Reprint.) November, 1901 30,000

Alkali Lands. By Milton Whitney and Thomas H. Means. Pp. 23, fig. 1. Farmers' Bulletin No. 88. (Reprint.) November, 1901 20,000

Soil Survey from Raleigh to Newbern, N. C. By William G. Smith. Pp. iii, 187–205, figs. 2. (Reprinted from the Report on Field Operations of the Division of Soils for 1900.) December, 1901 1,000

Application of the Theory of Solution to the Study of Soils. By Frank K. Cameron. Pp. iii, 423–453. (Reprinted from the Report on Field Operations of the Division of Soils for 1900.) December, 1901 500

Soil Survey Around Imperial, Cal. By Thos. H. Means and J. Garnett Holmes. Pp. 20, figs. 2. Circular No. 9. January, 1902 2,500

Reprint, February, 1902 1,000

Report of the Chief of the Division of Soils for 1901. By Milton Whitney. Pp. iii, 113–140. (From Annual Reports, Department of Agriculture.) January, 1902 6,000

Soil Survey in Salt River Valley, Arizona. By Thos. H. Means. Pp. v, 287–332. (Reprinted from the Report on Field Operations of the Division of Soils for 1900.) March, 1902 1,500

Growing Sumatra Tobacco Under Shade in the Connecticut Valley. By Milton Whitney. Pp. 21, pls. 7, figs. 2. Bulletin No. 20. April, 1902. Price, 10 cents 10,000

Copies.

Instructions to Field Parties and Description of Soil Types. Field season, 1902. Bureau of Soils. Pp. 73. April, 1902 300

A Soil Survey Around Lancaster, Pa. By Clarence W. Dorsey. Pp. iii, 61–84, pls. 4, figs. 2, map. (Reprinted from the Report on Field Operations of the Division of Soils for 1900.) April, 1902 2,000

Soil Survey, Montgomery County, Ohio. By Clarence W. Dorsey and George N. Coffey. Pp. ii, 85–102, pls. 3, figs. 4, map 1. (Reprinted from the Report on Field Operations of the Division of Soils for 1900.) April, 1902 1,500

Soil Survey of Cecil County, Md. By Clarence W. Dorsey and Jay A. Bonsteel. Pp. ii, 103–124, figs. 6, map 1. (Reprinted from the Report on Field Operations of the Division of Soils for 1900.) April, 1902 1,000

Soil Survey of St. Mary County, Md. By Jay A. Bonsteel. Pp. ii, 125–145, figs. 4, map 1. (Reprinted from the Report on Field Operations of the Division of Soils for 1900.) April, 1902 1,500

Soil Survey of Calvert County, Md. By Jay A. Bonsteel and R. T. Avon Burke. Pp. iii, 147–171, fig. 1, map 1. (Reprinted from the Report on Field Operations of the Division of Soils for 1900.) April, 1902 1,500

Soil Survey of Kent County, Md. By Jay A. Bonsteel. Pp. ii, 173–186, map. (Reprinted from the Report on Field Operations of the Division of Soils for 1900.) April, 1902 1,500

Soil Survey Around Santa Ana, Cal. By J. Garnett Holmes. Pp. iii, 385–412, pls. 8, figs. 2, maps 2. (Reprinted from the Report on Field Operations of the Division of Soils for 1900.) April, 1902 500

Capillary Studies and Filtration of Clay from Soil Solutions. By Lyman J. Briggs and Macy H. Lapham. Pp. 40, figs. 5. Bulletin No. 19. May, 1902. Price, 5 cents 2,200

The Purpose of a Soil Survey. By Milton Whitney, Chief of the Bureau of Soils. Pp iii, 117–132. (Reprint from Yearbook of Department of Agriculture for 1901.) May, 1902 100

Soil Survey in Weber County, Utah. By Frank D. Gardner and Charles A. Jensen. Pp. iii, 207–247, pl. 1, maps 3. (Reprinted from the Report on Field Operations of the Division of Soils for 1900.) May, 1902 500

Soil Survey in the Sevier Valley, Utah. By Frank D. Gardner and Charles A. Jensen. Pp. iv, 243–285, pls. 7, figs. 7, maps 4. (Reprinted from the Report on Field Operations of the Division of Soils for 1900.) May, 1902 500

Soil Survey Around Fresno, Cal. By Thomas H. Means and J. Garnett Holmes. Pp. iv, 333–384, pls. 16, figs. 8, maps 2. (Reprinted from the Report on Field Operations of the Division of Soils for 1900.) May, 1902 1,000

DIVISION OF STATISTICS.

Statistical Matter Relating to Principal Crops and Farm Animals, Transportation Rates, etc., in the United States, 1900. Pp. 753–861. (Reprint from Yearbook of Department of Agriculture for 1900.) July, 1901 10,000

Reprint, September, 1901 1,000

Rates of Charge for Transporting Garden Truck, with Notes on the Growth of the Industry. By Edward G. Ward, Jr., Expert in Transportation Statistics, and Edwin S. Holmes, Jr., Special Agent. Pp. 86, Bulletin No. 21, miscellaneous series. August, 1901. Price, 5 cents 10,000

Influence of Rye on the Price of Wheat. By Edward T. Peters, of the Division of Statistics. Pp. iii, 167–182. (Reprint from the Yearbook of the U. S. Department of Agriculture for 1901.) August, 1901 1,000

Wheat Growing and General Agricultural Conditions in the Pacific Coast Region of the United States. By Edwin S. Holmes, Jr., Division of Statistics. Pp. 44, maps 4, pls. 8. Bulletin No. 20, miscellaneous series. September, 1901. Price, 10 cents 10,000

Reprint, December, 1901 5,000

Wages of Farm Labor in the United States. Results of Eleven Statistical Investigations, 1866–1899. Prepared Under the Direction of the Statistician. Pp. 47. Bulletin No. 22, miscellaneous series. September, 1901. Price, 5 cents 30,000

Statistics on the Fruit Industry of California. By Edwin S. Holmes, Jr., Field Agent, Division of Statistics. Pp. 11. Bulletin No. 23, miscellaneous series. December, 1901. Price, 5 cents 10,000

	Copies.
Changes in the Rates of Charge for Railway and Other Transportation Services. By H. T. Newcomb. Revised by Edward G. Ward, Jr., Expert in Transportation Statistics. Pp. 86. Bulletin No. 15, miscellaneous series. Revised edition. February, 1902. Price, 5 cents	20,000
Report of the Statistician. By John Hyde. Pp. 341–344. (Reprinted from Annual Reports Department of Agriculture for 1901.) March, 1902	300
Report of the Statistician for 1900. By John Hyde. Pp. 293–297. (Reprinted from Annual Reports Department of Agriculture for 1900.) April, 1902	300
The Future Demand for American Cotton. By J. L. Watkins, Cotton Expert, Division of Statistics. Pp. ii, 193–206. (Reprint from Yearbook of Department of Agriculture for 1901.) May, 1902	2,000
The Cotton-Seed Industry. By Charles M. Daugherty, of the Division of Statistics. Pp. ii, 285–298. (Reprint from Yearbook of Department of Agriculture for 1901.) May, 1902	1,000
Crop Reporter. Vol. 3, No. 3. Pp. 8. July, 1901	85,000
Crop Reporter. Vol. 3, No. 4. Pp. 8. August, 1901	95,000
Crop Reporter. Vol. 3, No. 5. Pp. 8. September, 1901	93,000
Crop Reporter. Vol. 3, No. 6. Pp. 8. October, 1901	93,000
Crop Reporter. Vol. 3, No. 7. Pp. 8. November, 1901	94,000
Crop Reporter. Vol. 3, No. 8. Pp. 8. December, 1901	93,000
Crop Reporter. Vol. 3, No. 9. Pp. 8. January, 1902	94,000
Crop Reporter. Vol. 3, No. 10. Pp. 8. February, 1902	94,000
Crop Reporter. Vol. 3, No. 11. Pp. 8. March, 1902	94,000
Crop Reporter. Vol. 3, No. 12. Pp. 8. April, 1902	94,000
Crop Reporter. Vol. 4, No. 1. Pp. 8. May, 1902	94,000
Crop Reporter. Vol. 1, No. 3. Pp. 4. July, 1899 (Rep.)	500
Crop Reporter. Vol. 4, No. 2. Pp. 8. June, 1902	94,000
Crop Reporter. Vol. 1, No. 1. Pp. 4. May, 1899 (Rep.)	500

WEATHER BUREAU.

Monthly Weather Review (A summary by months of weather conditions throughout the United States, based upon reports of nearly 3,000 regular and voluntary observers). Quarto size. Price 20 cents each.	
Vol. XXIX, No. 4. April, 1901. Pp. 145–199, charts 9	4,500
Vol. XXIX, No. 5. May, 1901. Pp. 201–241, pls. 4, charts 10	4,500
Vol. XXIX, No. 6. June, 1901. Pp. 243–289, pls. 4, figs. 2, charts 9	4,500
Vol. XXIX, No. 7. July, 1901. Pp. 291–339, pl. 1, charts 9	4,500
Vol. XXIX, No. 8. August, 1901. Pp. 341–397, pls. 3, charts 8	4,500
Vol. XXIX, No. 9. September, 1901. Pp. 399–445, charts 10	4,550
Vol. XXIX, No. 10. October, 1901. Pp. 447–487, pl. 1, figs. 2, charts 9	4,550
Vol. XXIX, No. 11. November, 1901. Pp. 489–533, charts 13	4,600
Vol. XXIX, No. 12. December, 1901. Pp. 535–589, charts 10	4,600
Vol. XXIX. Annual Summary for 1901. Pp. ix, 591–613, charts 7	4,600
Vol. XXX, No. 1. January, 1902. Pp. 1–59, charts 10	4,600
Vol. XXX, No. 2. February, 1902. Pp. 61–108, charts 10	4,600
Vol. XXX, No. 3. March, 1902. Pp. 109–156, charts 9	4,600
Compilation of Weather Forecasts. By Alfred J. Henry, Professor of Meteorology, Weather Bureau. Pp. iii, 107–114, pls. 3, fig. 1. (Reprint from Yearbook U. S. Department of Agriculture for 1900.) August, 1901	2,000
Hot Waves: Conditions Which Produce Them and Their Effect on Agriculture. By Alvin T. Burrows, Observer, Weather Bureau. Pp. iii, 325–336, pls. 3. (Reprint from Yearbook U. S. Department of Agriculture for 1900.) August, 1901	2,000
Special Report on the Hurricane of August 13–16, 1901, on the Louisiana and Mississippi coasts. By Isaac M. Cline, Forecast Official in charge of the West Gulf district at New Orleans, La. September, 1901. Pp. 6	2,000
Weather Bureau Exhibit, Pan-American Exhibition. By D. T. Maring, Weather Bureau. Prepared under the direction of Willis L. Moore, Chief U. S. Weather Bureau. Pp. 4, frontispiece, pls. 3. (W. B. No. 248.) September, 1901	3,000

	Copies.
Protection of Food Products from Injurious Temperatures. By H. E. Williams, Chief Clerk, Weather Bureau. Pp. 26. Farmers' Bulletin No. 125. (Reprint.) September, 1901	15,000
Reprint, January, 1902	25,000
Instructions for Voluntary Observers. Prepared under the direction of Willis L. Moore, Chief of Weather Bureau. Pp. 28, frontispiece, figs. 8. Second edition, comprising circulars B and C, Instrument Division. (W. B. No. 250.) November, 1901	10,000
The Forecaster and the Newspaper. By Harvey Maitland Watts, of the Philadelphia Press. Read before the Convention of Weather Bureau Officials, Milwaukee, Wis., August 27–29, 1901. Pp. 22, maps 6. November, 1901	2,000
Instructions for the Care and Management of Sunshine Recorders. By C. F. Marvin, Professor of Meteorology. Prepared under the direction of Willis L. Moore, Chief U. S. Weather Bureau. Pp. 19, figs. 6. Circular G, Instrument Division, second edition. (W. B. No. 252.) December, 1901	1,000
Report of the Chief of the Weather Bureau. By Willis L. Moore. Pp. iii, 3–14. (From Annual Reports, Department of Agriculture.) December, 1901	3,000
Report of the Chief of the Weather Bureau 1900–1901. By Willis L. Moore, Chief. In two volumes. Vol. I, pp. 318. January, 1901	1,000
Meteorological Chart of the Great Lakes. Summary for the season of 1901. By Alfred J. Henry and Norman B. Conger. Prepared under direction of Willis L. Moore, Chief U. S. Weather Bureau. Pp. 32, charts 13. (W. B. No. 258.) January, 1902	1,500
Loss of Life in the United States by Lightning. Prepared under the direction of Willis L. Moore, Chief U. S. Weather Bureau, by Alfred J. Henry, Professor of Meteorology. Pp. 21, pls. 4. Bulletin No. 30. (W. B. No. 256.) February, 1902. Price 10 cents	2,500
Wind Velocity and Fluctuations of Water Level on Lake Erie. Prepared under the direction of Willis L. Moore, Chief U. S. Weather Bureau, by Alfred J. Henry, Professor of Meteorology. Pp. 22, charts. (W. B. No. 262.) May, 1902. Price, 50 cents	1,200
Meteorological Chart of the Great Lakes. No. 1, 1902. By Alfred J. Henry and Norman B. Conger. Prepared under the direction of Willis L. Moore, Chief U. S. Weather Bureau. Pp. 26, charts 2. (W. B. No. 264.) May, 1902	2,500
Floods and Flood Warnings. By H. C. Frankenfield, Forecast Official, Weather Bureau. Pp. ii, 477–486. (Reprint from Yearbook of Department of Agriculture for 1901.) May, 1902	200
The Chinook Winds. By Alvin T. Burrows, Observer, Weather Bureau. Pp. iii, 555–566, figs. 3. (Reprint from Yearbook of Department of Agriculture for 1901.) May, 1902	200
Eclipse Meteorology and Allied Problems. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by Frank H. Bigelow, M. A., L. H. D., Professor of Meteorology. Pp. 166, charts 43. (W. B. No. 267.) June, 1902. Price, 50 cents	1,500
Climate and Crop Bulletin No. 16. July 2, 1901	4,350
Climate and Crop Bulletin No. 17. July 9, 1901	4,350
Climate and Crop Bulletin No. 18. July 16, 1901	4,350
Climate and Crop Bulletin No. 19. July 23, 1901	4,350
Climate and Crop Bulletin No. 20. July 30, 1901	4,350
Climate and Crop Bulletin No. 21. August 5, 1901	4,400
Climate and Crop Bulletin No. 22. August 12, 1901	4,400
Climate and Crop Bulletin No. 23. August 19, 1901	4,400
Climate and Crop Bulletin No. 24. August 26, 1901	4,400
Climate and Crop Bulletin No. 25. September 2, 1901	4,400
Climate and Crop Bulletin No. 26. September 9, 1901	4,400
Climate and Crop Bulletin No. 27. September 16, 1901	4,400
Climate and Crop Bulletin No. 28. September 23, 1901	4,450
Climate and Crop Bulletin No. 29. September 30, 1901	4,450
Climate and Crop Bulletin No. 30. October, 1901	4,500
Climate and Crop Bulletin No. 31. November, 1901	4,800
Climate and Crop Bulletin No. 32. December, 1901	4,800

		Copies.
Climate and Crop Bulletin No. 1.	January, 1902	4,840
Climate and Crop Bulletin No. 2.	February, 1902	4,850
Climate and Crop Bulletin No. 3.	March, 1902	4,800
Climate and Crop Bulletin No. 4.	April 14, 1902	4,450
Climate and Crop Bulletin No. 5.	April 21, 1902	4,500
Climate and Crop Bulletin No. 6.	April 28, 1902	4,500
Climate and Crop Bulletin No. 7.	May 5, 1902	4,500
Climate and Crop Bulletin No. 8.	May 12, 1902	4,500
Climate and Crop Bulletin No. 9.	May 19, 1902	4,500
Climate and Crop Bulletin No. 10.	May 26, 1902	4,500
Climate and Crop Bulletin No. 11.	June 2, 1902	4,575
Climate and Crop Bulletin No. 12.	June 9, 1902	4,575
Climate and Crop Bulletin No. 13.	June 16, 1902	4,475
Climate and Crop Bulletin No. 14.	June 23, 1902	4,475
Climate and Crop Bulletin No. 15.	June 30, 1902	4,475
Snow and Ice Bulletin.	December 3, 1901	1,800
Snow and Ice Bulletin.	December 10, 1901	1,800
Snow and Ice Bulletin.	December 17, 1901	1,800
Snow and Ice Bulletin.	December 24, 1901	1,720
Snow and Ice Bulletin.	December 31, 1901	1,800
Snow and Ice Bulletin.	January 7, 1902	1,800
Snow and Ice Bulletin.	January 14, 1902	1,800
Snow and Ice Bulletin.	January 21, 1902	1,800
Snow and Ice Bulletin.	January 28, 1902	1,823
Snow and Ice Bulletin.	February 4, 1902	1,850
Snow and Ice Bulletin.	February 11, 1902	1,850
Snow and Ice Bulletin.	February 18, 1902	1,850
Snow and Ice Bulletin.	February 25, 1902	1,850
Snow and Ice Bulletin.	March 4, 1902	1,850
Snow and Ice Bulletin.	March 11, 1902	1,850
Snow and Ice Bulletin.	March 18, 1902	1,850
Snow and Ice Bulletin.	March 25, 1902	1,850
Daily Weather Map (showing weather conditions throughout the United States and giving forecasts of probable changes):		
July, 1901		43,250
August, 1901		44,150
September, 1901		45,175
October, 1901		44,300
November, 1901		45,500
December, 1901		46,660
January, 1902		42,500
February, 1902		43,200
March, 1902		43,827
April, 1902		42,500
May, 1902		43,210
June, 1902		44,500

APPENDIX B.

REPORT IN DETAIL OF PUBLICATIONS OF THE U. S. DEPARTMENT OF AGRICULTURE RECEIVED AND DISTRIBUTED DURING THE FISCAL YEAR ENDED JUNE 30, 1902, THE PUBLICATION OF WHICH IS PROVIDED FOR BY LAW.

[NOTE.—The publications of the Weather Bureau are not distributed from the Division of Publications, but by an official in that Bureau specially charged with such work, and directed by the order of the Secretary of Agriculture, dated March 29, 1897, to report to the chief of this Division. A list of Weather Bureau publications is given in separate tables.]

Publications other than Farmers' Bulletins received and distributed from July 1, 1901, to June 30, 1902.

Publication.	Received.	Distributed.
Publications printed prior to July 1, 1901		27,221
DIVISION OF ACCOUNTS AND DISBURSEMENTS.		
Report of the Chief for 1901	200	126
DIVISION OF AGROSTOLOGY.		
Bulletin No. 25	3,000	2,750
BUREAU OF ANIMAL INDUSTRY.		
Bulletin No. 29	14,400	12,820
Bulletin No. 30	1,000	1,000
Bulletin No. 31	10,000	9,000
Bulletin No. 32	20,000	16,191
Bulletin No. 33	20,000	14,260
Bulletin No. 35	2,000	1,366
Bulletin No. 36	7,000	2,162
Bulletin No. 37	10,000	6,430
Bulletin No. 39	2,000	1,416
Bulletin No. 40	4,000	4,000
Bulletin No. 41	6,000	5,918
Bulletin No. 42	2,000	701
Circular No. 23 (second revision)	20,000	19,465
Circular No. 25 (reprint)	1,000	1,000
Circular No. 31 (revised)	15,000	17,563
Circular No. 35	4,000	4,500
Circular No. 36	5,000	3,059
Circular No. 37	3,000	474
Report of Chief for 1901	500	274
Seventeenth Annual Report of the Bureau of Animal Industry for the year 1900	9,000	7,721
The Thirteenth International Congress, from Seventeenth Annual Report of Bureau of Animal Industry	300	300
The Bacillus of Tuberculosis, from Seventeenth Annual Report of Bureau of Animal Industry	300	300
Meat and Meat Products at the Paris Exposition of 1900, from Seventeenth Annual Report of Bureau of Animal Industry	1,500	422
The Free Distribution of Blackleg Vaccine, from Seventeenth Annual Report of Bureau of Animal Industry	3,500	208
Plant Poisoning of Stock in Montana, from Seventeenth Annual Report of Bureau of Animal Industry	1,000	256
Verminous Diseases of Cattle, etc., from Seventeenth Annual Report of Bureau of Animal Industry	2,000	445
Cattle Ticks of the United States, from Seventeenth Annual Report of Bureau of Animal Industry	1,000	205
Market Milk, etc., from Seventeenth Annual Report of Bureau of Animal Industry	8,000	7,230
Dairy Products at the Paris Exposition of 1900	12,000	12,000
Senate Document No. 168, Fifty-seventh Congress, first session. Statistics of Oleomargarine, Oleo Oil, and Filled Cheese	500	500
DIVISION OF BIOLOGICAL SURVEY.		
Bulletin No. 12	1,500	1,740
Bulletin No. 13	2,000	977
Bulletin No. 15	5,000	3,217
Bulletin No. 16	5,000	4,067
Circular No. 29	500	118
Circular No. 32	2,500	2,700
Circular No. 34	2,500	1,050
Circular No. 35	1,000	1,000
Circular No. 36	600	507

Publications other than Farmers' Bulletins received and distributed from July 1, 1901, to June 30, 1902—Continued.

Publication.	Received.	Distributed.
DIVISION OF BIOLOGICAL SURVEY—continued.		
Circular No. 37	1,000	1,000
Report of the Acting Chief, 1901	500	341
North American Fauna No. 20	3,000	1,666
North American Fauna No. 21	3,000	2,778
DIVISION OF BOTANY.		
Bulletin No. 16	5,000	2,187
Bulletin No. 26	500	485
Bulletin No. 27	5,000	3,484
Bulletin No. 28	4,000	3,483
Bulletin No. 29	5,000	3,008
Contributions from the U. S. National Herbarium, Vol. V, No. 6	1,000	1,000
Contributions from the U. S. National Herbarium, Vol. VI	1,000	1,000
Contributions from the U. S. National Herbarium, Vol. VII, No. 2	2,500	2,373
Contributions from the U. S. National Herbarium, Vol. VII, No. 3	1,000	1,000
BUREAU OF CHEMISTRY.		
Bulletin No. 13, Part 10	1,000	1,000
Bulletin No. 46	500	906
Bulletin No. 50	1,000	541
Bulletin No. 58	1,000	357
Bulletin No. 63	3,500	3,500
Bulletin No. 64	3,200	2,248
Bulletin No. 65	1,000	1,000
Reprint from Bulletin No. 67	500	500
Circular No. 3	1,000	1,000
Circular No. 7	1,000	621
Circular No. 8	1,000	1,000
Circular No. 9	1,500	819
Circular No. 10	1,500	832
Progress of the Beet-Sugar Industry in the United States in 1898	1,000	1,943
Methods of Analysis of Liquors	300	300
Methods of Examination of Meat and Meat Products	300	300
Methods of Analysis of Edible Oils, Fats, etc	300	300
Report of Chemist for 1901	500	212
DIVISION OF ENTOMOLOGY.		
Bulletin No. 4 (revised edition)	1,000	993
Bulletin No. 25 (reprint)	1,000	1,000
Bulletin No. 27	1,000	1,158
Bulletin No. 28	4,000	3,082
Bulletin No. 29	4,000	3,142
Bulletin No. 30	4,000	3,106
Bulletin No. 31	3,000	1,852
Bulletin No. 32	3,000	1,873
Bulletin No. 33	2,500	752
Bulletin No. 34	3,500	1,752
Bulletin No. 9 (technical series)	2,000	1,721
Reprint from Bulletin No. 31, Jarring of the Curculio, etc	200	200
Circular No. 9 (second series)	2,500	1,800
Circular No. 36 (reprint)	5,000	775
Circular No. 42 (second series)	5,000	871
Circular No. 44 (second series)	3,500	2,224
Circular No. 45 (second series)	2,500	1,016
Circular No. 47 (second series)	3,000	----------
Circular No. 48 (second series)	3,000	100
Circular No. 49 (second series)	3,000	----------
Report of the Entomologist for 1901	500	216
General Index to the Seven Volumes of Insect Life, 1888–1895	500	100
OFFICE OF EXPERIMENT STATIONS.		
Reprint from Bulletin No. 80, Inspection Work, etc	200	161
Bulletin No. 92 (reprint)	500	477
Bulletin No. 93 (reprint)	1,000	149
Bulletin No. 94 (reprint)	1,000	800
Bulletin No. 95 (reprint)	1,000	428
Bulletin No. 96 (reprint)	500	426
Bulletin No. 98	3,000	2,744
Bulletin No. 99	1,500	926
American Agricultural Experiment Stations, from Bulletin No. 99	200	25
What is Most Worth in Modern Education, from Bulletin No. 99	100	24
The Legislative Career of Justin S. Morrill, from Bulletin No. 99	200	24
The Connecticut Experiment Station, from Bulletin No. 99	100	25
General Drift of Education at Land-Grant Colleges, from Bulletin No. 99	100	24
Burley Tobacco, etc., from Bulletin No. 99	100	24

Publications other than Farmers' Bulletins received and distributed from July 1, 1901, to June 30, 1902—Continued.

Publication.	Received.	Distributed.
OFFICE OF EXPERIMENT STATIONS—continued.		
Methods of Experimenting with Cigar-Wrapper Leaf, from Bulletin No. 99	100	24
Available Energy of Food and Body Material, from Bulletin No. 99	100	24
Cooperative Field Experiments, from Bulletin No. 99	100	25
Cooperative Dairy Herd Tests, from Bulletin No. 99	100	35
Our New Agricultural Industry, from Bulletin No. 99	100	26
Plant Physiology in Relation to Horticulture and Agriculture, from Bulletin No. 99	100	100
Laboratory Work in Horticulture, from Bulletin No. 99	100	25
The Educational Status of Horticulture, from Bulletin No. 99	100	24
University Extension in Agriculture at Cornell University, from Bulletin No. 99	100	24
The Function of the Station Botanist, from Bulletin No. 99	100	24
Progress of Variety Testing in Experiment Station Work, from Bulletin No. 99	100	50
What our Experiment Stations have done in Originating Varieties of Plants, etc., from Bulletin No. 99	100	25
Seed and Plant Introduction, from Bulletin No. 99	100	24
Grass and Forage Plant Investigations in the United States	100	25
A Vegetation House Arranged for Pot Experiments, etc., from Bulletin No. 99	100	25
Entomology in the Southern States, from Bulletin No. 99	100	25
Suggestions Toward Greater Uniformity in Nursery Inspection Laws and Rulings, from Bulletin No. 99	100	24
Experiences in Nursery and Orchard Inspection, from Bulletin No. 99	100	24
Nursery Inspection, etc., from Bulletin No. 99	100	24
Recent Results with Hydrocyanic Acid Gas for Destruction of Insects, etc., from Bulletin No. 99	100	25
The Danger to American Horticulture from the Introduction of Injurious Scale Insects, from Bulletin No. 99	100	24
Nursery Inspection and Orchard Insecticide Work in Illinois, from Bulletin No. 99	100	24
A Little-Known Asparagus Pest, etc., from Bulletin No. 99	100	25
Economic Entomology in Florida, from Bulletin No. 99	100	50
The Relation of the Agricultural and Mechanical College to the State, from Bulletin No. 99	100	25
Some Observations upon *Artace punctistriga*, from Bulletin No. 99	100	24
The Student of Mechanic Arts, An Apprentice, from Bulletin No. 99	100	100
Bulletin No. 100	1,000	1,000
The Agricultural Situation in California, reprinted from Bulletin No. 100	500	287
Features and Water Rights of Yuba River, California, reprinted from Bulletin No. 100	500	210
Irrigation Investigations on Cache Creek, reprinted from Bulletin No. 100	500	231
Report of Investigation Problems in the Salinas Valley, reprinted from Bulletin No. 100	500	182
Irrigation from the San Joaquin River, reprinted from Bulletin No. 100	500	155
Irrigation from the San Joaquin River, reprinted from Bulletin No. 100	500	155
The Irrigation Problems of the Honey Lake Basin, reprinted from Bulletin No. 100	500	163
Problems of Water Storage on Torrential Streams of Southern California, reprinted from Bulletin No. 100	500	150
Water Appropriation from Kings River, reprinted from Bulletin No. 100	500	340
Bulletin No. 101	5,000	4,389
Bulletin No. 102	3,500	4,187
Bulletin No. 103	4,000	1,755
Bulletin No. 104	1,000	882
Bulletin No. 105	1,500	1,395
Bulletin No. 106	1,000	870
Bulletin No. 107	4,000	3,304
Bulletin No. 108	2,500	1,859
Bulletin No. 109	3,500	2,363
Bulletin No. 110	5,000	3,063
Bulletin No. 111	1,000	935
Bulletin No. 114	3,000	380
Foreign Experiment Stations, reprinted from Bulletin No. 111	3,700	79
Organization Lists of the Agricultural Colleges and Experiment Stations in the United States, reprinted from Bulletin No. 111	2,500	90
Report of Irrigation Investigations for 1900, No. 1, reprinted from Bulletin No. 104	1,000	----------
Report of Irrigation Investigations for 1900, No. 2, reprinted from Bulletin No. 104	1,000	----------
Report of Irrigation Investigations for 1900, No. 3, reprinted from Bulletin No. 104	1,000	----------
Report of Irrigation Investigations for 1900, No. 4, reprinted from Bulletin No. 104	1,000	----------
Circular No. 23	1,000	1,000
Circular No. 46	1,000	620
Report of the Director of the Office of Experiment Stations	3,000	2,039
Experiment Station Record, Vol. XII, No. 1 (reprinted)	500	150

Publications other than Farmers' Bulletins received and distributed from July 1, 1901, to June 30, 1902—Continued.

Publication.	Received.	Distributed.
OFFICE OF EXPERIMENT STATIONS—continued.		
Record, Vol. XII, No. 11	5,000	4,655
Record, Vol. XIII, No. 1	5,000	4,655
Record, Vol. XIII, No. 2	5,000	4,489
Record, Vol. XIII, No. 3	5,000	4,739
Record, Vol. XIII, No. 4	5,000	4,875
Record, Vol. XIII, No. 5	5,000	4,800
Record, Vol. XIII, No. 6	5,000	4,800
Record, Vol. XIII, No. 7	5,000	4,040
Record, Vol. XIII, No. 8	5,000	4,824
The Ash Constituents of Plants, etc., reprinted from Record, Vol. XIII, Nos. 3 and 4	200	200
Bulletin No. 1, Hawaii Experiment Station, Chickens and Their Diseases in Hawaii	5,000	3,718
Bulletin No. 1, Alaska Agricultural Experiment Station	3,000	1,518
Annual Report of the Office of Experiment Stations for the year ended June 30, 1901	6	6
BUREAU OF FORESTRY.		
Bulletin No. 7 (reprint)	1,000	206
Bulletin No. 10 (reprint)	3,000	1,000
Bulletin No. 12 (reprint)	2,500	208
Bulletin No. 17 (reprint)	1,000	659
Bulletin No. 26 (reprint)	3,000	838
Bulletin No. 29 (reprint)	5,000	3,408
Bulletin No. 30	10,000	2,496
Bulletin No. 31	7,200	5,381
Bulletin No. 32	10,000	753
Report of the Forester for 1901	10,000	7,461
Circular No. 23 (reprint)	12,000	9,210
House Doc. No. 181, Report upon the Forestry Investigations of the U. S. Department of Agriculture, 1877–1898 (reprint)	500	262
SECTION OF FOREIGN MARKETS.		
Bulletin No. 9 (reprint)	1,000	148
Bulletin No. 14 (reprint)	1,000	135
Bulletin No. 19 (reprint)	1,000	708
Bulletin No. 20 (reprint)	1,000	1,450
Bulletin No. 21 (reprint)	1,000	1,123
Bulletin No. 22 (reprint)	10,000	3,945
Bulletin No. 23 (reprint)	1,000	971
Bulletin No. 24 (reprint)	6,000	6,000
Bulletin No. 25 (reprint)	6,000	4,879
Bulletin No. 27	6,000	6,000
Circular No. 24	11,100	6,995
Report of the Chief of Foreign Markets for 1901	2,500	2,221
LIBRARY.		
Bulletin No. 36	1,000	804
Bulletin No. 37	1,000	918
Bulletin No. 38	1,000	1,000
Bulletin No. 39	1,000	936
Bulletin No. 40	750	3
Report of Librarian for 1901	200	152
DIVISION OF PUBLICATIONS.		
Monthly List of Publications for June, 1901	55,000	54,800
Monthly List of Publications for July, 1901	60,000	59,700
Monthly List of Publications for August, 1901	60,000	59,600
Monthly List of Publications for September, 1901	60,200	60,000
Monthly List of Publications for October, 1901	62,000	61,700
Monthly List of Publications for November, 1901	61,600	61,600
Monthly List of Publications for December, 1901	62,000	61,015
Monthly List of Publications for January, 1902	65,000	61,307
Monthly List of Publications for February, 1902	65,000	64,298
Monthly List of Publications for March, 1902	67,500	67,000
Monthly List of Publications for April, 1902	70,000	69,500
Monthly List of Publications for May, 1902	75,000	74,000
Circular No. 1	3,000	991
Report of the Editor for 1901	1,500	130
No. 179. List of Publications for Sale by Superintendent of Documents	10,000	12,984
No. 247. List of Publications for Free Distribution	10,000	11,850
DIVISION OF POMOLOGY.		
Bulletin No. 9	1,000	1,000
Bulletin No. 10	12,000	4,124

Publications other than Farmers' Bulletins received and distributed from July 1, 1901, to June 30, 1902—Continued.

Publication.	Received.	Distributed.
BUREAU OF PLANT INDUSTRY.		
Bulletin No. 1	2,500	2,333
Bulletin No. 2	2,500	1,874
Bulletin No. 3	4,500	2,566
Bulletin No. 4	5,000	1,599
Bulletin No. 5	1,000	1,000
Bulletin No. 6	2,500	1,011
Bulletin No. 7	2,500	2,094
Bulletin No. 8	2,000	1,123
Bulletin No. 9	2,000	1,079
Bulletin No. 10	3,000	1,005
Bulletin No. 11	5,000	1,115
Bulletin No. 12	2,500	672
Bulletin No. 13	2,500	1,085
Bulletin No. 14	3,000	3,000
Bulletin No. 15	2,500	1,186
Bulletin No. 16	2,500	960
Bulletin No. 17	5,000	2,797
Bulletin No. 18	3,000	2,329
Bulletin No. 19	3,000	2,940
Bulletin No. 25	25,000	3,907
Report of the Chief for 1901	1,000	290
OFFICE OF PUBLIC ROAD INQUIRIES.		
Bulletin No. 8	1,000	225
Bulletin No. 9	5,000	15
Bulletin No. 12	5,000	300
Bulletin No. 16	5,000	
Bulletin No. 21	20,000	12,930
Bulletin No. 26	5,000	3,475
Circular No. 23	15,000	400
Circular No. 27	1,000	350
Circular No. 30	10,000	1,700
Circular No. 34	5,000	3,896
Circular No. 36	1,100	838
Report of Director of Office of Public Road Inquiries for 1901	1,000	650
List of Road Publications	5,000	4,400
OFFICE OF THE SECRETARY.		
Preliminary Report of Secretary for 1901	45,000	45,000
Report 62 (reprint)	1,000	67
Report 69	2,000	1,250
Report 70	68,000	53,182
Report 71	3,000	2,102
Report 72	6	6
Yearbook of the Department for 1901	6	6
Annual Reports of the Department of Agriculture for 1901	3,000	2,800
Report of the Appointment Clerk	2,000	1,783
Senate Document No. 282, The Hot Springs of Arkansas	500	350
Report of the Chief of the Weather Bureau for 1901, from Annual Reports of the Department of Agriculture	3,000	2,900
BUREAU OF SOILS.		
Bulletin No. 16	500	65
Bulletin No. 18	2,500	1,089
Bulletin No. 19	2,200	1,314
Bulletin No. 20	10,000	3,567
Circular No. 8	3,500	3,350
Circular No. 9	3,500	3,044
Report of Chief for 1901	6,000	211
Instruction to Field Parties, etc	270	166
Field Operations of the Division of Soils for 1900	8,000	6,665
Soil Survey from Raleigh to Newbern, N. C., reprinted from Field Operations for 1900	1,000	240
Soil Survey in Salt River Valley, Arizona, reprinted from Report of Field Operations, 1900	1,500	1,500
Soil Survey of Calvert County, Md., reprinted from Report of Field Operations for 1900	1,500	1,048
Soil Survey of Montgomery County, Ohio, reprinted from Report of Field Operations for 1900	1,500	338
Soil Survey of Kent County, Md., reprint from Report of Field Operations for 1900	1,500	1,102
Soil Survey of Cecil County, Md., reprint from Report of Field Operations for 1900	1,000	791
Soil Survey of St. Mary County, Md., reprint from Report of Field Operations for 1900	1,500	1,164

Publications other than Farmers' Bulletins received and distributed from July 1, 1901, to June 30, 1902—Continued.

Publication.	Received.	Distributed.
BUREAU OF SOILS—continued.		
A Soil Survey Around Lancaster, Pa., reprint from report of Field Operations for 1900	2,000	1,429
Soil Survey Around Fresno, Cal., reprint from Report of Field Operations for 1900	1,000	922
General Review of the Work of the Division of Soils, reprint from Report of Field Operations for 1900	500	453
Soil Survey in Weber County, Utah, reprint from Report of Field Operations for 1900	500	419
Soil Survey in the Sevier Valley, Utah, reprint from Report of Field Operations for 1900	500	247
Soil Survey Around Santa Ana, Cal., reprint from Report of Field Operations for 1900	500	500
Application of the Theory of Solution to the Study of Soils, reprint from Report of Field Operations for 1900	500	457
Investigations on the Physical Properties of Soils, reprint from Report of Field Operations for 1900	500	455
DIVISION OF STATISTICS.		
Bulletin No. 15 (revised edition)	20,000	20,000
Bulletin No. 20	15,000	13,378
Bulletin No. 21	10,000	7,649
Bulletin No. 22	30,000	28,824
Bulletin No. 23	10,000	5,226
Report of the Statistician for 1900	300	300
Report of the Statistician for 1901	300	300
Crop Reporter, Vol. I, No. 1 (reprint)	500	500
Crop Reporter, Vol. III, No. 3	87,000	86,800
Crop Reporter, Vol. III, No. 4	97,500	97,300
Crop Reporter, Vol. III, No. 5	97,000	96,900
Crop Reporter, Vol. III, No. 6	93,000	92,600
Crop Reporter, Vol. III, No. 7	94,000	93,650
Crop Reporter, Vol. III, No. 8	95,000	94,800
Crop Reporter, Vol. III, No. 9	94,000	94,000
Crop Reporter, Vol. III, No. 10	94,000	94,000
Crop Reporter, Vol. III, No. 11	96,000	95,750
Crop Reporter, Vol. III, No. 12	98,500	98,000
Crop Reporter, Vol. IV, No. 1	98,500	98,300
Crop Reporter, Vol. IV, No. 2	98,000	97,000
DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY.		
Bulletin No. 14 (reprint)	1,000	54
Bulletin No. 28	2,000	1,144
Bulletin No. 29	5,000	2,324
Circular No. 18	20,000	4,800
EXTRACTS FROM YEARBOOKS.		
No. 85. Methods of Propagating the Orange and Other Citrus Fruits (revised), from Yearbook 1896	5,000	345
No. 118. Office of Road Inquiry, from Yearbook 1897	2,000	550
No. 181. Rise and Future of Irrigation in the United States, from Yearbook 1899	500	500
No. 192. Rabies, etc., from Yearbook 1900	1,000	300
No. 194. The Food of Nestling Birds, from Yearbook 1900	5,000	4,010
No. 195. Successful Wheat Growing in the Semiarid District, from Yearbook 1900	5,000	1,770
No. 196. Smyrna Fig Culture in the United States, from Yearbook 1900	1,000	558
No. 197. How Birds Affect the Orchard, from Yearbook 1900	5,000	1,585
No. 199. Dairy Products at Paris Exposition of 1900, from Yearbook 1900	1,000	616
No. 200. Statistical Matter Relating to Principal Crops and Farm Animals, from Yearbook 1900	11,000	9,865
No. 201. Practical Irrigation, from Yearbook 1900	3,000	1,851
No. 202. Amplification of Weather Forecasts, from Yearbook 1900	2,000	325
No. 203. Commercial Plant Introduction, from Yearbook 1900	5,000	410
No. 204. The Selection of Materials for Macadam Roads, from Yearbook 1900	3,000	3,000
No. 205. Hot Waves, etc., from Yearbook 1900	2,000	2,000
No. 206. Some Poisonous Plants of the Northern Stock Ranges, from Yearbook 1900	3,000	1,615
No. 207. The Scale Insect and Mite Enemies of Citrus Trees, from Yearbook 1900	1,000	637
No. 208. Fungous Diseases of Forest Trees, from Yearbook 1900	5,000	1,017
No. 209. Influence of Rye on the Price of Wheat, from Yearbook 1900	1,000	736
No. 210. Mountain Roads, from Yearbook 1900	3,000	3,000
No. 211. The World's Exhibit of Leaf Tobacco at the Paris Exposition, from Yearbook 1900	4,000	2,018
No. 212. Forest Extension in the Middle West, from Yearbook 1900	25,000	20,520

Publications other than Farmers' Bulletins received and distributed from July 1, 1901, to June 30, 1902—Continued.

Publication.	Received.	Distributed.
EXTRACTS FROM YEARBOOKS—continued.		
No. 213. The Value of Potatoes as Food, from Yearbook 1900	3,000	515
No. 214. Practical Forestry in the Southern Appalachians, from Yearbook 1900	10,000	9,374
No. 215. Commercial Pear Culture, from Yearbook 1900	5,000	756
No. 216. Objects and Methods of Investigating Certain Physical Properties of Soils, from Yearbook 1900	1,000	1,000
No. 217. Developing of the Trucking Interests, from Yearbook 1900	5,000	350
No. 218. The Date Palm and Its Culture, from Yearbook 1900	3,000	750
No. 219. Free Delivery of Rural Mails, from Yearbook 1900	1,000	390
No. 220. Testing Commercial Varieties of Vegetables, from Yearbook 1900	2,000	239
No. 221. The Use and Abuse of Food Preservatives, from Yearbook 1900	3,000	547
No. 222. The Influence of Refrigeration on the Fruit Industry, from Yearbook 1900	4,000	950
No. 223. Our Native Pasture Plants, from Yearbook 1900	2,000	525
No. 224. William Saunders, from Yearbook 1900	250	250
No. 225. The Relation of Nutrition to the Health of Plants, from Yearbook 1901	1,000	100
No. 226. Mohair and Mohair Manufactures, from Yearbook 1901	100	75
No. 228. Some Typical Reservoirs in the Rocky Mountain States, from Yearbook 1901	600	600
No. 230. Commercial Apple Orcharding, from Yearbook 1901	2,000	103
No. 231. The Tuberculin Test for Tuberculosis, from Yearbook 1901	1,000	250
No. 232. The Purpose of a Soil Survey, from Yearbook 1901	200	142
No. 233. Some Problems of the Rural Common School, from Yearbook 1901	3,000	175
No. 234. The Future Demand for American Cotton, from Yearbook 1901	2,000	315
No. 235. Insects as Carriers and Spreaders of Diseases, from Yearbook 1901	700	300
No. 236. The Timber Resources of Nebraska, from Yearbook 1901	5,000	103
No. 237. Progress in Plant and Animal Breeding, from Yearbook 1901	1,000	104
No. 238. Agricultural Seeds: Where Grown and How Handled, from Yearbook 1901	500	
No. 239. The Cotton-Seed Industry, from Yearbook 1901	1,000	250
No. 240. Road Building with Convict Labor in the Southern States, from Yearbook 1901	5,000	200
No. 241. Grazing in the Forest Reserves, from Yearbook 1901	5,000	218
No. 242. Agriculture in the Tropical Islands of the United States, from Yearbook 1901	700	103
No. 243. The Present Status of the Mexican Cotton-Boll Weevil, from Yearbook 1901	700	100
No. 244. Dietaries in Public Institutions, from Yearbook 1901	3,000	100
No. 245. Government Cooperation in Object-Lesson Road Work, from Yearbook 1901	2,000	300
No. 246. The Home Fruit Gardens, from Yearbook 1901	3,000	16
No. 247. Two Vanishing Game Birds: The Woodcock and the Wood Duck, from Yearbook 1901	8,000	2,511
No. 248. Experimental Work with Fungous Diseases of Grasshoppers, from Yearbook 1901	700	100
No. 250. Floods and Flood Warnings, from Yearbook 1901	200	100
No. 252. Agricultural Investigations in the Island Possessions of the United States, from Yearbook 1901	1,500	230
No. 255. The Chinook Winds, from Yearbook 1901	200	100
No. 257. Influence of Environment on the Chemical Composition of Plants, from Yearbook 1901	1,000	238
	3,138,828	2,714,661

Farmers' Bulletins printed, and Congressional and miscellaneous distribution, for the fiscal year 1901–1902.

No. of bulletin.	Title of bulletin.	Total number received.	Distributed to Congressmen.	Miscellaneous distribution.
16	Leguminous Plants	20,000	17,952	9,000
17	Peach Yellows and Peach Rosette	----------	8,897	1,135
20	Washed Soils: How to Prevent and Reclaim Them	----------	1,841	1,647
21	Barnyard Manure	61,375	44,138	11,350
22	The Feeding of Farm Animals	70,627	57,567	13,060
23	Foods: Nutritive Value and Cost	----------	8,873	5,183
24	Hog Cholera and Swine Plague	81,000	66,919	13,175
25	Peanuts: Culture and Uses	30,550	24,183	7,873
26	Sweet Potatoes: Culture and Uses	----------	2,732	2,908
27	Flax for Seed and Fiber	20,500	8,339	3,423
28	Weeds: And How to Kill Them	47,330	35,819	11,579
29	Souring and Other Changes in Milk	20,625	29,750	7,660
30	Grape Diseases on the Pacific Coast	15,000	4,435	3,971
31	Alfalfa and Lucern	60,677	38,480	10,611
32	Silos and Silage	34,100	24,509	8,805
33	Peach Growing for Market	20,200	27,795	8,842
34	Meats: Composition and Cooking	46,000	25,931	8,559
35	Potato Culture	76,000	69,457	15,974
36	Cotton Seed and Its Products	20,900	18,438	4,602
37	Kafir Corn: Culture and Uses	40,000	18,963	7,777
38	Spraying for Fruit Diseases	65,000	35,777	10,882
39	Onion Culture	20,300	30,394	12,889
40	Farm Drainage	30,495	25,542	7,197
41	Fowls: Care and Feeding	79,500	65,846	17,823
42	Facts About Milk	49,890	39,277	9,333
43	Sewage Disposal on the Farm	30,800	9,079	5,523
44	Commercial Fertilizers	40,510	35,918	8,363
45	Insects Injurious to Stored Grain	40,000	26,362	6,028
46	Irrigation in Humid Climates	20,000	5,140	4,643
47	Insects Affecting the Cotton Plant	30,116	22,032	3,290
48	The Manuring of Cotton	35,935	28,719	3,461
49	Sheep Feeding	101,550	56,288	8,242
50	Sorghum as a Forage Crop	39,775	31,155	7,733
51	Standard Varieties of Chickens	140,260	112,806	18,204
52	The Sugar Beet	20,302	42,980	6,428
53	How to Grow Mushrooms	45,650	16,796	7,308
54	Some Common Birds	64,750	35,807	10,268
55	The Dairy Herd	77,000	68,823	10,315
56	Experiment Station Work—I	40,000	23,348	6,762
57	Butter Making on the Farm	65,800	60,983	10,176
58	The Soy Bean as a Forage Crop	40,400	30,333	7,098
59	Bee Keeping	70,000	34,530	10,343
60	Methods of Curing Tobacco	41,000	23,607	4,917
61	Asparagus Culture	20,260	28,908	8,329
62	Marketing Farm Produce	50,000	38,036	8,806
63	Care of Milk on the Farm	64,700	50,526	12,475
64	Ducks and Geese	79,830	61,558	11,726
65	Experiment Station Work—II	44,900	18,679	6,271
66	Meadows and Pastures	51,100	42,120	8,301
67	Forestry for Farmers	5,000	9,864	6,202
68	The Black Rot of the Cabbage	30,510	15,862	5,854
69	Experiment Station Work—III	25,000	20,149	5,908
70	Insect Enemies of the Grape	30,000	12,053	6,558
71	Essentials in Beef Production	30,300	44,028	5,959
72	Cattle Ranges of the Southwest	40,815	8,572	4,352
73	Experiment Station Work—IV	40,866	18,112	5,835
74	Milk as Food	40,720	31,055	8,625
75	The Grain Smuts	25,000	29,828	6,510
76	Tomato Growing	55,200	51,348	14,696
77	The Liming of Soils	25,000	15,046	8,697
78	Experiment Station Work—V	85,900	17,207	6,428
79	Experiment Station Work—VI	30,500	14,299	5,833
80	The Peach Twig Borer	15,000	18,029	6,665
81	Corn Culture in the South	51,400	41,118	5,628
82	The Culture of Tobacco	31,200	28,706	5,505
83	Tobacco Soils	20,000	17,406	5,349
84	Experiment Station Work—VII	60,300	17,031	5,979
85	Fish as Food	41,100	19,517	7,207
86	Thirty Poisonous Plants	20,000	21,346	9,280
87	Experiment Station Work—VIII	40,700	17,099	6,011
88	Alkali Lands	20,200	5,672	3,677
89	Cowpeas	60,900	61,451	10,538
90	The Manufacture of Sorghum Sirup	----------	5,069	2,083
91	Potato Diseases and Treatment	70,000	71,742	9,696
92	Experiment Station Work—IX	41,350	19,984	10,254
93	Sugar as Food	35,700	12,126	6,663
94	The Vegetable Garden	60,651	63,872	15,207
95	Good Roads for Farmers	70,730	80,622	8,807
96	Raising Sheep for Mutton	80,100	64,433	7,052

Farmers' Bulletins printed, and Congressional and miscellaneous distribution, for the fiscal year 1901–1902—Continued.

No. of bulletin.	Title of bulletin.	Total number received.	Distributed to Congressmen.	Miscellaneous distribution.
97	Experiment Station Work—X	41,471	12,987	5,896
98	Suggestions to Southern Farmers	41,932	31,453	9,446
99	Insect Enemies of Shade Trees	24,900	24,811	6,186
100	Hog Raising in the South	62,660	49,183	6,838
101	Millets	46,175	20,474	6,086
102	Southern Forage Plants	40,982	33,591	8,913
103	Experiment Station Work—XI	41,500	14,413	10,576
104	Notes on Frost	----------	12,563	6,281
105	Experiment Station Work—XII	34,800	15,232	5,823
106	Breeds of Dairy Cattle	60,000	84,037	12,056
107	Experiment Station Work—XIII	46,000	22,765	10,369
108	Saltbushes	59,689	4,744	4,985
109	Farmers' Reading Courses	40,900	46,396	7,642
110	Rice Culture in the United States	20,700	9,857	3,785
111	Farmers' Interest in Good Seed	75,000	53,886	6,079
112	Bread and Bread Making	65,550	53,342	10,575
113	The Apple and How to Grow It	70,575	61,784	22,863
114	Experiment Station Work—XIV	35,300	18,294	7,049
115	Hop Culture in California	20,050	3,716	2,489
116	Irrigation in Fruit Growing	19,900	16,518	6,205
117	Sheep, Hogs, and Horses in the Northwest	30,000	47,553	7,922
118	Grape Growing in the South	----------	23,998	5,433
119	Experiment Station Work—XV	30,000	19,631	7,114
120	Insects Affecting Tobacco	30,412	16,463	4,160
121	Beans, Peas, and Other Legumes as Food	20,000	39,577	7,827
122	Experiment Station Work—XVI	20,000	21,020	6,412
123	Red Clover Seed: Information for Purchasers	59,600	32,338	8,108
124	Experiment Station Work—XVII	36,000	33,623	7,021
125	Protection of Food Products from Injurious Temperatures	41,800	25,563	5,554
126	Practical Suggestions for Farm Buildings	104,880	95,553	15,059
127	Important Insecticides	60,270	54,630	11,159
128	Eggs and Their Uses as Food	65,885	54,205	11,418
129	Sweet Potatoes	55,760	56,801	11,021
130	The Mexican Cotton Boll Weevil	20,400	14,129	6,495
131	Household Test for Detection of Oleomargarine and Renovated Butter	45,450	44,967	10,351
132	Insect Enemies of Growing Wheat	75,397	50,484	10,300
133	Experiment Station Work—XVIII	70,100	32,155	16,803
134	Tree Planting in Rural School Grounds	94,430	49,199	33,668
135	Sorghum Sirup Manufacture	69,895	34,936	14,043
136	Earth Roads	71,814	54,167	17,647
137	The Angora Goat	70,000	43,380	18,540
138	Irrigation in Field and Garden	57,300	21,801	12,838
139	Emmer: A Grain for the Semiarid Regions	50,000	10,181	9,289
140	Pineapple Growing	30,000	4,863	6,341
141	Poultry Raising on the Farm	145,500	90,687	40,512
142	The Nutritive and Economical Value of Food	70,000	31,664	23,225
143	The Conformation of Beef and Dairy Cattle	50,000	34,385	12,440
144	Experiment Station Work—XIX	60,300	31,309	24,494
145	Carbon Bisulphid as an Insecticide	50,400	5,325	14,895
146	Insecticides and Fungicides	51,600	13,732	14,666
147	Winter Forage Crops for the South	45,000	20,480	5,608
148	Celery Culture	45,300	19,622	23,743
149	Experiment Station Work—XX	60,000	23,812	14,709
150	Clearing New Land	60,000	12,419	4,143
151	Dairying in the South	30,000	5,451	2,072
152	Scabies in Cattle	35,000	8,279	2,141
153	Orchard Enemies in the Pacific Northwest	30,000	3,567	2,089
154	The Fruit Garden Preparation and Care	30,000	17,891	2,267
155	How Insects Affect Health in Rural Districts	30,000	10,207	2,789
		6,199,426	4,289,126	1,240,884

Publications received and distributed by the Weather Bureau during the year ended June 30, 1902, by quarters.

Number and title of publication.	Number of copies.
QUARTER ENDED SEPTEMBER 30, 1901.	
Received.	
No. 246. Monthly Weather Review for May, 1901	4,500
No. 247. Monthly Weather Review for June, 1901	4,500
No. 248. Weather Bureau Exhibit, Pan-American Exposition	3,000
No. 249. Monthly Weather Review for July, 1901	4,500
Special Report on the Hurrricane of August 13-16, 1901, on the Louisiana and Mississippi Coasts	2,000
Bound Washington Daily Weather Maps from July 1, 1899, to December 31, 1899	11
Bound Monthly Weather Reviews, January, 1900, to December, 1900	200
Washington Daily Weather Maps	132,575
Climate and Crop Bulletin	57,508
Distributed.	
Report of Chief of Weather Bureau, 1891-92	3
Report of Chief of Weather Bureau, 1893	3
Report of Chief of Weather Bureau, 1894	4
Report of Chief of Weather Bureau, 1895-96	3
Report of Chief of Weather Bureau, 1896-97	3
Report of Chief of Weather Bureau, 1897-98	3
Report of Chief of Weather Bureau, 1898-99	4
Report of Chief of Weather Bureau, 1899-1900, Vol. I	6
Report of Chief of Weather Bureau, 1899-1900, Vol. II	5
Separates from Report of Chief of Weather Bureau, 1891-92	9
Separates from Report of Chief of Weather Bureau, 1894	4
Separates from Report of Chief of Weather Bureau, 1895-96	5
Separates from Report of Chief of Weather Bureau, 1896-97	17
Separates from Report of Chief of Weather Bureau, 1897-98	18
Separates from Report of Chief of Weather Bureau, 1898-99	10
Separates from Report of Chief of Weather Bureau, 1899-1900	39
Weather Bureau Bulletin, No. 11, Part III	2
Weather Bureau Bulletin, No. 22	5
Weather Bureau Bulletin, No. 24	8
Weather Bureau Bulletin, No. 25	16
Weather Bureau Bulletin, No. 26	53
Weather Bureau Bulletin, No. 28	2
Weather Bureau Bulletin, A	1
Weather Bureau Bulletin, C	4
Weather Bureau Bulletin, D	16
Weather Bureau Bulletin, E	3
Weather Bureau Bulletin, F	2
Weather Bureau Bulletin, G	4
Weather Bureau Bulletin, H	5
Special Report on the Hurricane of August 13-16, 1901, on the Louisiana and Mississippi Coasts	2,000
Description of Cloud Forms	190
No. 246. Monthly Weather Review for May, 1901	4,450
No. 247. Monthly Weather Review for June, 1901	4,450
No. 248. Weather Bureau Exhibit, Pan-American Exposition	3,000
No. 249. Weather Review for July, 1901	4,450
Bound Washington Daily Weather Maps from July 1, 1899, to December 31, 1899	11
Bound Monthly Weather Review from January, 1900, to December, 1900	200
Washington Daily Weather Map	132,575
Climate and Crop Bulletin	57,508
QUARTER ENDED DECEMBER 31, 1901.	
Received.	
No. 250. Instructions for Voluntary Observers (second edition)	5,000
No. 251. Monthly Weather Review for August, 1901	4,500
No. 252. Circular G, Instrument Division. Instructions for the Care and Management of Sunshine Recorders (second edition)	1,000
No. 253. Monthly Weather Review for September, 1901	4,550
No. 254. The Solar Constant	500
No. 255. Monthly Weather Review for October, 1901	4,550
The Forecaster and the Newspaper (pamphlet)	1,000
Report of the Chief of the Weather Bureau, 1899-1900	30
Washington Daily Weather Maps	136,460
Climate and Crop Bulletins	14,200
Snow and Ice Bulletins	7,350

Publications received and distributed by the Weather Bureau during the year ended June 30, 1902, by quarters—Continued.

Number and title of publication.	Number of copies.
QUARTER ENDED DECEMBER 31, 1901—continued.	
Distributed.	
Report of Chief of Weather Bureau, 1891–92	3
Report of Chief of Weather Bureau, 1895–96	4
Report of Chief of Weather Bureau, 1898–99, Vol. II	5
Report of Chief of Weather Bureau, 1899–1900	2
Separates from Report of Chief of Weather Bureau, 1891–92	560
Separates from Report of Chief of Weather Bureau, 1895–96	4
Separates from Report of Chief of Weather Bureau, 1896–97	67
Separates from Report of Chief of Weather Bureau, 1897–98	41
Separates from Report of Chief of Weather Bureau, 1899–1900	30
Weather Bureau Bulletin, No. 14	3
Weather Bureau Bulletin, No. 16	2
Weather Bureau Bulletin, No. 22	4
Weather Bureau Bulletin, No. 25	16
Weather Bureau Bulletin, No. 25	38
Weather Bureau Bulletin, C	5
Weather Bureau Bulletin, D	56
Weather Bureau Bulletin, E	3
Weather Bureau Bulletin, F	2
Weather Bureau Bulletin, G	2
The Forecaster and the Newspaper	1,000
Description of Cloud Forms	73
Washington Daily Weather Map	136,460
Climate and Crop Bulletins	14,290
Snow and Ice Bulletins	7,350
No. 250. Instructions for Voluntary Observers (second edition)	5,000
No. 251. Monthly Weather Review for August, 1901	4,450
No. 252. Circular G, Instrument Division. Instructions for the Care and Management of Sunshine Recorders (second edition)	1,000
No. 253. Monthly Weather Review for September, 1901	4,500
No. 254. The Solar Constant	300
No. 255. Monthly Weather Review for October, 1901	4,500
QUARTER ENDED MARCH 31, 1902.	
Received.	
No. 256. Loss of Life in the United States by Lightning. Bulletin No. 30	2,500
No. 257. Monthly Weather Review, November, 1901	4,600
No. 258. Meteorological Chart of the Great Lakes, Summary for the Season of 1901. No. 2, 1901	1,500
No. 259. Monthly Weather Review, December, 1901	4,600
No. 260. Monthly Weather Review. (Annual Summary.) 1901	4,600
Report of the Chief of the Weather Bureau, 1900–1901. (In two volumes.) Vol. I	1,000
Washington Daily Weather Map	129,527
Climate and Crop Bulletins	14,534
Snow and Ice Bulletins	23,593
Bound Daily Weather Maps, July 1, 1900, to December 31, 1900	30
Bound Daily Weather Maps, August 10, 1900, to December 31, 1900	70
Distributed.	
Report of Chief of Weather Bureau, 1891–92	25
Report of Chief of Weather Bureau, 1893	3
Report of Chief of Weather Bureau, 1894	113
Report of Chief of Weather Bureau, 1895–96	5
Report of Chief of Weather Bureau, 1898–99	1
Report of Chief of Weather Bureau, 1899–1900	3
Report of Chief of Weather Bureau, 1900–1901, Vol. I	872
Separates from Report of Chief of Weather Bureau, 1901–2	25
Separates from Report of Chief of Weather Bureau, 1894	228
Separates from Report of Chief of Weather Bureau, 1895–96	328
Separates from Report of Chief of Weather Bureau, 1896–97	34
Separates from Report of Chief of Weather Bureau, 1897–98	50
Separates from Report of Chief of Weather Bureau, 1898–99	6
Separates from Report of Chief of Weather Bureau, 1899–1900	39
Weather Bureau Bulletin, No. 25	16
Weather Bureau Bulletin, No. 26	42
Weather Bureau Bulletin, C	3
Weather Bureau Bulletin, D	55
Weather Bureau Bulletin, E	2
Weather Bureau Bulletin, F	2
Weather Bureau Bulletin, G	2
Description of Cloud Forms	53
Washington Daily Weather Map	129,527
Climate and Crop Bulletins	14,534
Snow and Ice Bulletins	23,593
Bound Daily Weather Maps, July, 1900, to December 31, 1900	27

Publications received and distributed by the Weather Bureau during the year ended June 30, 1902, by quarters—Continued.

Number and title of publication.	Number of copies.
QUARTER ENDED MARCH 31, 1902—continued.	
Distributed—Continued.	
Bound Daily Weather Maps, August 10, 1900, to December 31, 1900	69
No. 254. Solar Constants	200
No. 256. Loss of Life in the United States by Lightning. Bulletin No. 30	1,600
No. 257. Monthly Weather Review, November, 1901	4,550
No. 258. Meteorological Chart of the Great Lakes, Summary for the Season of 1901. No. 2, 1901	1,500
No. 259. Monthly Weather Review, December, 1901	4,550
No. 260. Monthly Weather Review. (Annual Summary.) 1901	4,550
QUARTER ENDED JUNE 30, 1902.	
Received.	
No. 261. Monthly Weather Review, January, 1902	4,600
No. 262. Bulletin J. Wind Velocity and Fluctuations of Water Level on Lake Erie	1,200
No. 263. Monthly Weather Review, February, 1902	4,600
No. 264. Meteorological Chart of the Great Lakes. No. 1, 1902	2,500
No. 266. Monthly Weather Review for March, 1902	4,600
Climate and Crop Bulletins, bound	7
Washington Daily Weather Map	130,210
Climate and Crop Bulletins	52,957
Distributed.	
Report of Chief of Weather Bureau, 1891-92	4
Report of Chief of Weather Bureau, 1893	4
Report of Chief of Weather Bureau, 1894	5
Report of Chief of Weather Bureau, 1895-96	2
Report of Chief of Weather Bureau, 1896-97	1
Report of Chief of Weather Bureau, 1897-98	2
Report of Chief of Weather Bureau, 1898-99	3
Report of Chief of Weather Bureau, 1899-1900	3
Report of Chief of Weather Bureau, 1900-1901, Vol. I	8
Separates from Report of Chief of Weather Bureau, 1891-92	8
Separates from Report of Chief of Weather Bureau, 1894	7
Separates from Report of Chief of Weather Bureau, 1895-96	12
Separates from Report of Chief of Weather Bureau, 1896-97	18
Separates from Report of Chief of Weather Bureau, 1897-98	24
Separates from Report of Chief of Weather Bureau, 1898-99	15
Separates from Report of Chief of Weather Bureau, 1899-1900	26
Separates from Report of Chief of Weather Bureau, 1890-1901	120
Weather Bureau Bulletin, No. 22	7
Weather Bureau Bulletin, No. 25	9
Weather Bureau Bulletin, No. 26	58
Weather Bureau Bulletin, No. 30	22
Weather Bureau Bulletin, C	5
Weather Bureau Bulletin, D	24
Weather Bureau Bulletin, E	2
Weather Bureau Bulletin, F	3
Weather Bureau Bulletin, G	1
Weather Bureau Bulletin, H	6
Weather Bureau Bulletin, J	1,000
Description of Cloud Forms	105
Bound Climate and Crop Bulletins, 1891	7
Washington Daily Weather Map	130,210
Climate and Crop Bulletins	52,957
No. 261. Monthly Weather Review, January, 1902	4,550
No. 263. Monthly Weather Review, February, 1902	4,550
No. 264. Meteorological Chart of the Great Lakes	2,300
No. 266. Monthly Weather Review, March, 1902	4,550

REPORT OF THE CHIEF OF THE SECTION OF FOREIGN MARKETS.

U. S. Department of Agriculture,
Division of Foreign Markets,
Washington, D. C., September 1, 1902.

Sir: I have the honor to submit herewith the report of the Section of Foreign Markets for the fiscal year ended June 30, 1902.

Respectfully,

Frank H. Hitchcock,
Chief.

Hon. James Wilson, *Secretary.*

WORK OF THE YEAR.

During the past year the office force of the Section of Foreign Markets, although somewhat larger than in the year preceding, was taxed to its utmost to meet the various demands for information regarding our agricultural export trade. The correspondence of the office was greater than ever before, indicating a more general appreciation of the importance of wider foreign markets in which to sell the surplus produce of American farms.

TRADE RELATIONS WITH CUBA.

As a result of the active discussion that occurred during the last session of Congress in reference to a plan for commercial reciprocity with Cuba, the office received many requests for information relative to our commerce with that island and particularly regarding importations of Cuban sugar. Considerable time was accordingly devoted to a study of the sugar import trade, special attention being given to the matter of price and to the several factors affecting price, including the costs incident to transportation. Much statistical information was compiled in response to inquiries on this subject.

Some of the sugar-trade statistics prepared by the office were published in the last report[a] of t' e Department's special agent having charge of investigations regarding the beet-sugar industry of the United States.

At the request of the Senate Committee on Relations with Cuba the chief of the Section appeared before that committee as a witness on the subject of our import trade in sugar.

THE BRITISH MARKET.

During the year a further special inquiry was begun as regards the condition of our agricultural export trade with the United Kingdom, where we find our principal foreign market. The increasing competition we are obliged to meet in that market, particularly on the part of some of the British colonial dependencies, makes it important to

[a] Report No. 72, "Progress of the beet-sugar industry in the United States in 1901," by Charles F. Saylor.

keep a careful watch for any change in conditions that may affect the sale there of American products. Within the past few years the countries that are our most active competitors in the British market, and especially Australasia and Canada, have taken additional measures to develop their agricultural export trade, and with such success as to render their competition a more serious matter than ever before.

AGENT STUDYING BRITISH IMPORTS.

In view of this growing competition the office has sent an agent to the United Kingdom to investigate at close range the present trade situation there, and especially the relative status in that market of exports received from the United States and from competing countries. The facts brought out by these investigations will be published in special reports. It is hoped that much timely information will thus be made available regarding the steps our competitors are taking to secure a larger share of the British trade and that suggestions will be offered of decided helpfulness to American exporters in meeting such competition.

IMPORTANCE OF AGENTS ABROAD.

As the competitive struggle for foreign business increases it becomes necessary to regard more carefully the special requirements of the markets sought and to give closer attention to the details of trade methods. It is believed that properly qualified agents stationed abroad can render valuable service in supplying information needed along these lines.

Not only should there be expert agents in the leading countries of importation to study and report upon the condition of the markets there and the opportunities they afford for trade extension, but it is likewise desirable to have competent representatives of the Department in the principal exporting countries for the purpose of procuring exact information as to the methods employed by our competitors in preparing produce for shipment and also regarding the measures they take to preserve that produce in good condition during transit from place of origin to final destination.

The leading agricultural countries with which we are obliged to compete are adopting this plan. They are sending their agents not only to the principal importing countries for the purpose of keeping in touch with the changing conditions of foreign markets, but also to the foremost exporting countries in order that they may profit by having knowledge of the latest and best export methods used by their competitors. The United States would undoubtedly find a similar policy of decided advantage.

In this connection it should be stated that the special agent the Department recently sent to Argentina for the purpose primarily of investigating the cattle industry there has incidentally rendered this office considerable service by securing information regarding Argentine export methods.

All possible steps will be taken by the office to extend its facilities for conducting investigations of this character in order that information obtainable only by personal inquiry abroad may be placed at the disposal of our exporters. It is doubtful if the means provided for carrying on the work of this office can be more profitably utilized than in the quest for such information.

TRADE IN FORESTRY PRODUCTS.

The more active interest recently aroused in the question of forestry in the United States has created a larger demand for statistical information regarding our commerce in forestry products. To meet this demand the office devoted considerable time during the year to the preparation of statistics on the subject. The publications hitherto issued by the office with reference to our agricultural trade have not included products of the forest. In view of the inquiries received, however, it will hereafter be the plan of the office to publish also from time to time reports on this branch of our foreign trade.

EXPORTS OF FOREST PRODUCTS.

During the past fiscal year the United States exported nearly $50,000,000 worth of forest products. Lumber in its various forms, not including heavy timber, comprised the principal item, the shipments under this head having a value of about $26,000,000. The exports of heavy timber, sawed, hewn, or in logs, were valued at about $10,000,000. Wood pulp and the minor products of the forest together formed an item of about $13,000,000.

Europe furnishes the principal foreign markets for American lumber. The United Kingdom is decidedly the largest purchaser, but important sales are also made each year to France and to Germany. The shipments of lumber, including timber, sent from the United States to the British market in 1902 had a value of fully $10,000,000. Our exports to France during that year, and likewise our exports to Germany, were valued at over $2,000,000.

The United States annually supplies large quantities of lumber to the neighboring countries of Canada and Mexico. During the past year Canada made purchases to the value of over $3,000,000 and Mexico to the value of over $2,000,000.

A promising market is being developed on the island of Cuba, where in 1902 consignments worth over $1,000,000 were received from the United States.

Our lumber is also purchased in considerable quantities by some of the South American countries, and particularly by Argentina, the shipments to the latter destination during the past year having a value of over $1,000,000.

Africa is another continent with which we are establishing a growing export business in lumber. Our consignments to Africa during 1902 were worth nearly $1,000,000. They went chiefly to British South Africa.

British Australasia has become a considerable purchaser of United States lumber, affording one of the most promising markets for our Pacific coast region. The shipments sent to Australasia during the past year were valued at over $1,000,000.

Important foreign markets for the great timber districts of the Pacific slope will undoubtedly be developed also in the Orient. American lumber is already being marketed quite extensively in that quarter of the world. During the last few years a considerable export business in lumber has been established with the Philippine Islands, where in 1902 shipments valued at $246,000 found a market. It is probable that this trade will be largely extended.

IMPORTS OF FOREST PRODUCTS.

Notwithstanding the immense timber areas of the United States, a larger sum is annually expended in the importation of forest products than is received in payment for such products exported. This is because of our extensive requirements as regards certain articles yielded only by the forests of the Tropics. Our imports of forest products during 1902 were valued at about $60,000,000. With the exception of about $13,000,000 worth of lumber, most of which was supplied by Canada, these imports consisted chiefly of articles that are derived from tropical countries and can not be produced in the United States. India rubber, of which there were imports valued at nearly $25,000,000, ranked foremost in this class of articles. Forest gums comprised another item of leading importance, the import value amounting to about $8,000,000. There was also a considerable importation of cabinet woods, and especially of mahogany, the principal part of which came from Central America, Mexico, and Cuba.

It is quite probable that before many years the island dependencies of the United States lying within the Tropics, and particularly the Philippine Islands, will supply a large part of the tropical forest products we are now obliged to import from foreign sources.

TRADE IN AGRICULTURAL PRODUCTS DURING 1902.

Although final returns as to the foreign trade of the United States during the fiscal year 1902 are not yet completed, the office has prepared from preliminary figures a compilation showing that our agricultural exports for the year mentioned had a value of about $860,000,000 and our agricultural imports a value of about $410,000,000.

AGRICULTURAL EXPORTS.

Compared with the record-breaking figures of the preceding year, the agricultural export value for 1902 discloses a rather marked decline. Next to the exceptional record for 1901, however, it is the largest value ever reported, being decidedly above the average of the decade.

The decline from the high mark reached by our agricultural exports in 1901 was principally due to the fact that a serious shortage in the corn crop left a comparatively small supply of this important export grain available for shipment to foreign markets. Our exports of corn during 1902 amounted in value to only $16,000,000, while in 1901 we sent abroad consignments worth nearly $83,000,000. The loss to our trade through the diminished shipment of this product alone exceeded $66,000,000.

Aside from the extraordinary falling off in corn exportation, the most noticeable instance of decline occurred in the value of cotton shipments. Our cotton exports for 1902 had a value of $292,000,000, or about $23,000,000 less than the figures recorded in 1901, when there were shipments worth $315,000,000.

Other products of agriculture exported less extensively during 1902 than in the year before were cattle, fresh beef, bacon, tallow, oats, wheat flour, cotton-seed oil, and fruits and nuts.

While the export trade in wheat flour, which was one of the products just mentioned, showed a rather large falling off last year, our shipments of wheat in the grain increased quite materially, the export

value for 1902 amounting to $113,000,000, as compared with only $97,000,000 for the year before.

Another agricultural export that showed a considerable gain during 1902 was lard. The shipments of this product for the year in question had a value of $52,000,000, whereas our exports for 1901 were worth only $47,000,000.

Among the additional articles in our agricultural export trade that made gains during the last fiscal year were hams, canned beef, fresh pork, lard substitutes, flaxseed, barley, oil cake, horses, and hay.

AGRICULTURAL IMPORTS.

While a considerable falling off occurred during the fiscal year 1902 in our agricultural export trade, there was an increase of about $20,000,000 in the value of our agricultural imports.

The products that contributed most extensively to this increase were silk, hides and skins, coffee, and wool.

TRADE WITH ISLAND POSSESSIONS.

In view of the lively interest that is taken in the course of trade between the United States and the several island possessions, the office recently prepared some statistics to show the status, so far as products of agriculture are concerned, of our commerce during the past fiscal year with Hawaii, Porto Rico, and the Philippines. From the statistics in question it appeared that while our agricultural trade with Hawaii suffered a rather marked decline in 1902, there was a considerable increase in the amount of such business carried on with Porto Rico and with the Philippine Islands.

In the trade with Porto Rico a decided growth occurred as regards both exportation and importation. Our exports of farm produce to that island during 1902 reached a value of $4,800,000, while the record of the year before was only $3,490,000.

In the case of our agricultural imports from Porto Rico the value advanced from $5,475,000 for 1901 to $7,000,000 for the year just passed.

The agricultural exports that showed the largest gains in our trade with Porto Rico were rice, beans and peas, wheat flour, and pork products.

The growth of our agricultural import trade with that island was due chiefly to larger purchases of sugar.

During 1902 the United States shipped to the Philippine Islands only $1,700,000 worth of farm produce as compared with $2,500,000 worth in 1901, but in the case of our agricultural imports from the islands there was a large growth, the value advancing from $4,375,000 in 1900 to $6,500,000 in 1902.

Among the exports in our Philippine trade that showed a decline were malt liquors and distilled spirits. The growth that occurred in our agricultural imports from the Philippines was chiefly traceable to larger takings of Manila hemp.

While exact figures are not available as to our agricultural export trade with Hawaii in 1901 and 1902, estimates have been made placing the value for the former year at about $4,600,000 and the value for the latter year at about $4,000,000. According to these estimates there was a falling off of about $600,000 in 1902.

Our agricultural imports from Hawaii during 1902 were valued at $24,000,000, showing a marked decline as compared with 1901, when a value of $27,637,000 was recorded. A falling off in the value of the sugar imported, caused by lower prices, accounted largely for the decline.

PUBLICATIONS.

Owing to the large amount of time required to conduct the growing correspondence of the office and to meet the various demands for trade information, fewer publications than usual were prepared during the past year.

The principal publication of the year was a report on the agricultural import trade of the United Kingdom. The object of this report was to show how extensively our imports to the British market are obliged to meet the competition of products from other exporting countries, and to suggest opportunities along certain lines for the extension of our trade in that market.

Reports like those issued in previous years were published, dealing respectively with the distribution of our agricultural exports and the sources of our agricultural imports.

A report was also published, according to the annual custom of the office, reviewing the general features of our foreign trade in agricultural products during the past year, and comparing the status of our agricultural imports and exports with that of preceding years.

The last mentioned report was supplemented, as in previous years, by a brief circular presenting the most important statistical facts regarding our agricultural trade.

PLANS FOR THE CURRENT YEAR.

As suggested above, it is the purpose of the office to give special attention during the present year to the study of trade conditions and methods abroad, not only in the leading importing countries that furnish the world's greatest markets, but also in the principal exporting countries with which we have to compete in our contest for those markets.

In the matter of publications, a leading feature of the work will be the preparation of reports after the plan of that recently issued on the agricultural import trade of the United Kingdom. Similar bulletins will be prepared in due course as regards Germany, the Netherlands, France, and other countries.

The information compiled in reference to our trade in forestry products will be utilized in a special report to be issued on that subject.

Bulletins similar to those previously published on the sources of our agricultural imports and the distribution of our agricultural exports will be issued as usual.

The bulletin heretofore published annually under the title of "Our foreign trade in agricultural products" will hereafter be condensed into smaller form and issued as a circular, doing away with the yearly circular entitled "Agricultural imports and exports."

CHANGE IN ORGANIZATION.

In accordance with a provision of the last agricultural appropriation bill, this office will hereafter be known as the Division of Foreign Markets instead of the Section of Foreign Markets.

REPORT OF THE APPOINTMENT CLERK.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE APPOINTMENT CLERK,
Washington, D. C., October 1, 1902.

SIR: I have the honor to submit herewith a report respecting the officers, employees, etc., constituting the organized working body of the U. S. Department of Agriculture as it existed on July 1, 1902, and the regulations governing promotions, etc., governing appointment to position of mere unskilled laborers, and other regulations at this date in force in the U. S. Department of Agriculture.

Respectfully,

J. B. BENNETT,
Appointment Clerk.

Hon. JAMES WILSON, *Secretary.*

WORKING FORCE OF DEPARTMENT OF AGRICULTURE TO JULY 1, 1902.

ESTABLISHMENT AND DEVELOPMENT OF THE DEPARTMENT OF AGRICULTURE.

On September 30, 1861, the Agricultural Division of the Department of the Interior, being the immediate predecessor of the U. S. Department of Agriculture, consisted of nine persons.

The U. S. Department of Agriculture was established on July 1, 1862, by an act of Congress approved May 15, 1862.

The following shows the development of the force of the Department from September 30, 1863, to July 1, 1902:

Date.	Number.	Date.	Number.
1863, September 30	29	1891, July 1 (including Weather Bureau, transferred to U. S. Department of Agriculture on July 1, 1891)	1,577
1867, September 30	99	1893, July 1	1,870
1871, September 30	84	1895, July 1	2,043
1873, September 30	92	1897, July 1	2,444
1875, September 30	90	1899, July 1	2,965
1877, September 30	77	1900, November 16	3,128
1879, June 30	93	1901, July 1	3,388
1881, July 1	108	1902, July 1	3,789
1883, July 1	239		
1885, July 1	214		
1887, July 1	328		
1889, July 1	488		

COMMISSIONERS AND SECRETARIES OF AGRICULTURE.

The table on the next page gives the name and length of service of each Commissioner and Secretary of Agriculture since the organization of the Department.

Name and length of service of each Commissioner and Secretary of Agriculture since the organization of the U. S. Department of Agriculture, July 1, 1862.

Name.	Rank.	Appointed under the Administration of President—	Date. appointed.	Date. terminated.
Isaac Newton	Commissioner	A. Lincoln	July 1,1862	June 19,1867
John W. Stokes	do	A. Johnson	June 20,1867	Dec. 4,1867
Horace Capron	do	A. Johnson	Dec. 5,1867	July 31,1871
Frederick Watts	do	U. S. Grant	Aug. 1,1871	June 30,1877
Wm. G. Le Duc	do	R. B. Hayes	July 1,1877	June 30,1881
Geo. B. Loring	do	J. A. Garfield	July 1,1881	Apr. 3,1885
Norman J. Colman	do	G. Cleveland	Apr. 4,1885	Feb. 12,1889
Norman J. Colman	Secretary	G. Cleveland	Feb. 13,1889	Mar. 6,1889
J. M. Rusk	do	B. Harrison	Mar. 7,1889	Mar. 6,1893
J. Sterling Morton	do	G. Cleveland	Mar. 7,1893	Mar. 5,1897
James Wilson	do	Wm. McKinley	Mar. 6,1897	Mar. 5,1901
James Wilson	do	Wm. McKinley	Mar. 6,1901	

CHANGES IN EMPLOYEES IN THE DEPARTMENT DURING FISCAL YEAR ENDED JUNE 30, 1902.

The following shows the changes in the employees in the classified service of the U. S. Department of Agriculture during the fiscal year beginning July 1, 1901, and terminating June 30, 1902:

	Number.
Selected and appointed from U. S. Civil Service Commission certificates	276
Reinstated upon U. S. Civil Service Commission certificates	10
Transfers to the Department upon U. S. Civil Service Commission certificates	19
Transfers from the Department upon U. S. Civil Service Commission certificates	1
Appointments upon U. S. Civil Service Commission certificates declined	35
Resignations	108
Removals	22
Deaths	14

EMPLOYEES IN DEPARTMENT OF AGRICULTURE JULY 1, 1902.

In the following is given the classes and number of employees in the Department of Agriculture on July 1, 1902:

Employees in the U. S. Department of Agriculture on July 1, 1902

SECRETARY'S OFFICE.

Executive officers	9
Clerks	18
Engineers, firemen, electricians, blacksmiths, plumbers, mechanics, messengers, laborers, and charwomen	39
	66

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

Chief and assistant chief of Division	2
Cashier	1
Clerks	12
Custodian of files	1
	16

DIVISION OF PUBLICATIONS.

Editor and chief of Division	1
Associate editor	1
Assistant editors	3
Editorial clerks	2
Artists, draftsmen, and engravers	4
Assistant in charge of document section	1
Foreman of document section	1
Folders and laborers in document section and in Farmers' Bulletin section	137
Clerks and copyists	12
	162

DIVISION OF STATISTICS.

Statistician and chief of Division	1
Assistant chief of Division	1
Clerks and compilers	54
Messengers and laborers	22
Special field agents	6
State statistical agents	38
Cotton statistical agents	7
	129

SECTION OF FOREIGN MARKETS.

Chief and assistant chief	2
Clerks and assistants	5
Laborers	4
	11

DIVISION OF ENTOMOLOGY.

Entomologist and chief of Division	1
Assistant chief of Division	1
Assistant entomologists, investigators, clerks, skilled laborers, messengers, and laborers	30
	32

DIVISION OF BIOLOGICAL SURVEY.

Biologist and chief of Division	1
Assistant chief of Division	1
Assistant biologists and clerks	14
Laborers	5
	21

DEPARTMENT LIBRARY.

Librarian in charge	1
Assistants, cataloguers, and clerks	7
Messengers	1
	9

DEPARTMENT MUSEUM.

Caretaker	1
Assistants and charwomen	4
	5

OFFICE OF PUBLIC ROAD INQUIRIES.

Director and assistant director	2
Agents, experts, clerks, and laborers	13
Chief of road-material laboratory	1
Experts, assistants, and laborers in road-material laboratory	7
	23

OFFICE OF EXPERIMENT STATIONS.

Director and assistant director	2
Chiefs of divisions	2
Assistants and clerks	23
Messengers and laborers	8
Agents and experts in the field	20
Irrigation engineers	3
Irrigation assistants and experts	8
Nutrition agents, experts, and assistants	17
Agents, experts, and assistants in Alaska	4
Agents, experts, and assistants in Hawaii	4
Agents and experts in Porto Rico	5
	96

BUREAU OF PLANT INDUSTRY.

Chief of Bureau	1
Physiologist and Pathologist	1
Chief clerk	1
Physiologists and assistant physiologists	6
Pathologists and assistant pathologists	8
Botanist and assistant botanists	8
Pomologist and assistant pomologists	6
Agrostologist and assistant agrostologists	5
Horticulturist	1
Cerealist	1
Agricultural explorer	1
Superintendent of weighing and mailing in seed distribution	1
Inspector and superintendent of records in seed distribution	1
Scientific assistants	6
Experts	18
Special agents	19
Assistants	5
Mycologist	1
Assistant curators	3
Clerks	40
Artists	2
Modeler	1
Scientific aids	12
Student assistants	4
Collaborators	8
Dispatch agent	1
Gardeners	6
Carpenters	4
Painter	1
Plant packer	1
Messengers	2
Fireman	1
Laborers in Vegetable Physiological and Pathological Investigations	18
Laborers in Botanical Investigations	16
Laborers in Pomological Investigations	2
Laborers in Grass and Forage Plant Investigations	9
Laborers in Gardens and Grounds	13
Laborers in Seed and Plant Introduction	2
Laborers in seed distribution	28
Laborers on Arlington Farm	12
Charwomen	2
	278

BUREAU OF FORESTRY.

Forester and chief of Bureau	1
Assistant foresters	4
Experts, agents, agents and experts, and expert assistants	24
Field assistants	14
Lumberman	1
Stenographers and clerks	23
Draftsmen	2
Computers	2
Assistant forest experts	27
Dendro-chemist	1
Photographers	3
Collaborators	19
Laborers	32
Student assistants	94
	247

BUREAU OF CHEMISTRY.

Chief and assistant chief of Bureau	2
Chiefs of laboratories	6
Assistant chemists	7

Microscopist	1
Clerks	4
Special agents	10
Student assistants	5
Aids	2
Engineer	1
Laborers	12
	50

BUREAU OF SOILS.

Soil physicist and chief of Bureau	1
Soil chemists	2
Soil analyst	1
Field assistants	36
Experts in soil management	10
Tobacco specialists	11
Scientific aids	10
Clerks	16
Laborers	7
Watchmen	2
Messenger	1
Charwomen	2
	99

BUREAU OF ANIMAL INDUSTRY.

Chief and assistant chief of Bureau	2
Chief clerk	1
Chiefs and assistant chiefs of divisions	7
Assistants	7
Zoologist	1
Superintendent and assistant of experiment station	2
Firemen	2
Messengers	3
Skilled laborers	2
Artist	1
Assistants	4
Carpenter	1
Meat inspectors and assistant meat inspectors	319
Live-stock and special agents	13
Special agent and agricultural explorer	1
Agents	2
Agents and experts and special agents and experts	15
Expert in animal husbandry	1
Experts and assistant experts in animal nutrition	3
Expert investigator	1
Vessel inspectors	3
Special inspector of live stock	1
Veterinary inspectors	6
Superintendents of animal quarantine stations	2
Stock examiners	184
Taggers	245
Clerks	80
Microscopists and assistant microscopists	255
Laborers	113
	1,277

WEATHER BUREAU.

Executive officers, chiefs and assistant chiefs of bureaus, divisions, offices, and sections	7
Clerks	75
Copyists	8
Mechanics	9
Artisans	7
Repairmen	6

Skilled laborers	0
Engineers	1
Firemen	3
Messengers	17
Watchmen	4
Charwomen	3
Laborers	23
Professors of meteorology	7
Medico-climatologist	1
Forecast officials	7
Local forecast officials	28
Section directors	31
Student assistants	15
Inspectors	3
Meteorological observers	263
River observers	125
Rainfall observers	33
Cotton-region observers	140
Corn and wheat observers	133
Fruit and wheat observers	19
Sugar and rice observers	8
Storm-warning displaymen	135
Compositors, proof readers, lithographers, printers, pressmen, folders, and feeders	44
Agents and station agents	7
Messengers on stations	106
	1,268
Total employees	3,789

RECAPITULATION.

Total number of officers and employees in the U. S. Department of Agriculture on—	
July 1, 1893	1,870
July 1, 1902	3,789
Increase	1,919
Number of officers and employees in the U. S. Department of Agriculture on July 1, 1902:	
Executive officers and administrative assistants, clerks, messengers, and watchmen	1,209
Scientists and scientific assistants	2,081
Laborers and charwomen	499
Total	3,789

CLASSIFIED CIVIL SERVICE.

Number of employees in the classified civil service	2,371
Number of persons excepted from the requirements of examination and certification in the classified civil service, including, also, the number unclassified	1,418
Total	3,789

EMPLOYEES IN THE DEPARTMENT WHOSE APPOINTMENT PRECEDES JULY 2, 1887.

The table on the next page gives the names of employees on the rolls of the U. S. Department of Agriculture on July 1, 1902, the date of whose appointment precedes July 2, 1887, covering a period of fifteen years or more, and the date of the appointment of each, respectively, but not including persons in the Weather Bureau.

Employees on the rolls of the Department of Agriculture (not including the Weather Bureau) July 1, 1902, whose appointment precedes July 2, 1887.

[In the "Remarks" column "out" means out of the service of the Department.]

Name.	Date appointed.	Remarks.
Adams, Jacob	May 11, 1889	Out from June 30, 1893, to April 1, 1898.
Alexander, Sarah C	Dec. 30, 1885	
Alexander, William	June 20, 1883	
Alvord, Henry E	Nov. 27, 1885	Out from March 31, 1889, to May 11, 1895.
Barnes, Almont	Oct. 1, 1868	Out from July 1, 1871, to August 1, 1890. Out from November 15, 1893, to April 3, 1896
Bartholow, Francis A	Dec. 9, 1886	
Beal, Foster E. L	Dec. 6, 1886	
Berry, Allen L	Aug. 5, 1885	
Blankman, Rosie B	May 31, 1884	
Bowie, Mary S	Feb. 15, 1887	
Bradford, Virginia P	Oct. 1, 1885	Out from February 25, 1892, to April 2, 1900.
Bragdon, Clara K	Dec. 5, 1885	
Breedin, Louise	Oct. 4, 1881	
Burke, Edmund	Apr. 15, 1869	
Burr, M. Helen	Jan. 3, 1882	
Carter, George	Jan. 1, 1887	
Champney, Mary G	Sept. 14, 1881	
Chapman, Mary T	Jan. 11, 1886	Out from April 15, 1886, to December 6, 1886.
Church, John P	Feb. 25, 1882	
Clark, Emma L	Aug. 16, 1882	
Colman, Marie A. S	May 2, 1885	Out from July 15, 1893, to August 26, 1896.
Cook, Richard H	Feb. 1, 1864	
Coquillet, Daniel W	June 29, 1887	
Cox, Frances C	July 18, 1883	
Coyle, Thomas	Jan. 15, 1888	
Crain, Anna C	Oct. 20, 1886	
Dent, Mary T	Apr. 2, 1887	
Dodge, Allen	Aug. 1, 1881	Out from July 7, 1895, to July 1, 1896.
Du Bois, Carrie L	May 7, 1883	
Edwards, Ella	May 1, 1882	
Evans, Frank L	July 1, 1875	
Fairfax, Thadeus	Dec. 3, 1885	
Farrington, A. M	Aug. 1, 1884	
Faville, George C	Apr. 21, 1887	
Finckel, Charlotte B	June 1, 1882	
Fisher, Albert K	July 1, 1885	
Gallagher, Lawrence	Jan. —, 1879	
Gardner, Helen	Jan. 1, 1885	
Gardner, Julia	Oct. 1, 1886	
Goodchild, Martha A	July 1, 1884	
Gregory, Fannie N	July 15, 1882	
Halley, James	July 1, 1862	
Halley, William	Oct. 15, 1868	Out from May 13, 1885, to January 31, 1891.
Harvey, John A	Aug. 1, 1878	
Hassall, Albert	May 24, 1887	Out from April 24, 1890, to March 7, 1891.
Hauser, Ernest	June 30, 1879	
Heidemann, Otto	June 1, 1883	Out from January 30, 1894, to August 3, 1898.
Howard, Leland O	Nov. 15, 1878	
Humphrey, William E	Sept. 24, 1880	
Ingram, Martha M	June 15, 1882	
Jenkins, Sarah E	Nov. 15, 1881	
Johnson, Martin A	June 27, 1883	Out from July 3, 1885, to September 27, 1886.
Jones, Edward B	Mar. 5, 1884	
Keleher, Thomas A	Jan. —, 1884	
Kerr, James K	July 1, 1862	
King, William M	June 30, 1885	Out from November 30, 1893, to April 21, 1897.
Lamson-Scribner, Frank	May 11, 1885	Out from October 4, 1888, to March 24, 1894.
Latham, Ella G	Feb. 12, 1883	
Love, Amelia H	May 7, 1882	Out from September 10, 1894, to April 29, 1897.
Lyons, Evelyn	Sept. 1, 1882	
Mahon, Martha H	Sept. 2, 1885	
McCutchen, Marguerite	July 1, 1884	
Melvin, Alonzo D	Dec. 10, 1886	
Merriam, C. Hart	July 1, 1885	
Miller, Virginia	July 1, 1879	
Montgomery, Anna	June 18, 1883	
Morrison, Ada B	Oct. 1, 1886	
O'Donoghue, Clara	Apr. 13, 1887	
Parker, Alexander	Sept. 30, 1873	
Parker, Annie	May 2, 1887	
Pergande, Theodore	June 30, 1879	
Perry, James M	June 30, 1883	
Peters, Edward T	Oct. 13, 1883	
Quinn, Eva H	Sept. 1, 1882	Out from October 13, 1893, to May 10, 1897.
Ray, Thomas J	Mar. 15, 1865	
Riggles, Thomas	July 1, 1882	
Rose, W. H	July 16, 1884	
Rutledge, Thomas	Dec. 19, 1881	Out from March 15, 1894, to March 30, 1897.
Safford, Mary F	Dec. 10, 1883	
Salmon, Daniel E	July 1, 1881	

Employees on the rolls of the Department of Agriculture (not including the Weather Bureau) July 1, 1902, whose appointment precedes July 2, 1887—Con.

Name.	Date appointed.	Remarks.
Schmidt, Flora	June 15, 1883	
Schwarz, Eugene A	Nov. 15, 1878	
Smith, Erwin F	Sept. 20, 1886	
Smith, Lydia J	Mar. 5, 1885	
Smith, Robert E	Oct. 1, 1866	
Sommers, Sarah L	Aug. 12, 1879	
Spencer, Guilford L	July 12, 1883	Out from September 24, 1894, to February 13, 1895.
Stevens, Ernestine H	Sept. 25, 1877	Out from March 31, 1896, to March 17, 1897.
Stoddart, Mary C	Sept. 1, 1884	
Sudworth, George B	Aug. 31, 1886	Out from July 22, 1898, to March 16, 1899.
Sullivan, Lillie	June 18, 1882	
Sullivan, Mary	Nov. 1, 1884	
Trescot, Thomas C	Dec. 1, 1881	
Vining, Harriet L	Sept. 29, 1885	
Walden, Celena	Aug. 5, 1881	
Walter, Henry S	June 30, 1883	
Wharton, Virginia K	Oct. 2, 1882	Out from November 2, 1895, to November 21, 1896.
Wight, John C	July 1, 1884	
Wiley, Harvey W	Apr. 9, 1883	
Williams, Joseph	May 21, 1883	
Winfield, Alice M	Sept. 1, 1882	
Wood, Maria L	Dec. 1, 1881	Out from April 4, 1882, to August 1, 1882.
Wray, W. H	July 16, 1884	Out from May 9, 1885, to August 1, 1885; out from June 30, 1886, to August 27, 1886; out from March 31, 1888, to August 1, 1890.

WEATHER BUREAU EMPLOYEES WHOSE APPOINTMENT PRECEDES JULY 2, 1887.

The following gives the names of employees in the Weather Bureau of the U. S. Department of Agriculture on July 1, 1902, the date of whose appointment precedes July 2, 1887, the persons constituting the Weather Bureau having been transferred to the U. S. Department of Agriculture from the United States Army on July 1, 1891, previous to which date they were in the Signal Corps of the United States Army. The Weather Bureau was created by "An act to increase the efficiency and reduce the expenses of the Signal Corps of the Army, and to transfer the Weather Service to the Department of Agriculture," approved October 1, 1890.

Employees in the Weather Bureau July 1, 1902, whose appointment precedes July 2, 1887.

[In the "Remarks" column "out" means out of the service of the Department.]

Name.	Date appointed.	Remarks.
Abbe, Cleveland	Jan. 3, 1871	
Alciatore, Henry F	Dec. 1, 1886	Out from December 18, 1890, to May 12, 1891.
Allen, George	Jan. 20, 1872	Out from January 21, 1877, to March 16, 1881.
Ashton, Clinton J	Oct. 25, 1881	In Department of Agriculture proper from February 16, 1894, to August 15, 1898.
Ashton, John C	June 14, 1878	
Bailey, Wayland	Aug. 9, 1884	
Baldwin, Harrison McP	June 3, 1881	
Barry, James A	June 22, 1878	Out from September 21, 1888, to October 11, 1889.
Barwick, James A	Mar. 31, 1873	
Bate, Henry C	Sept. 16, 1886	
Bauer, Jacob W	July 23, 1883	
Beall, Samuel W	Sept. 25, 1871	
Bell, William	June 4, 1880	
Bennett, Maitland C	July 13, 1883	
Berry, James	July 8, 1878	
Berry, William	Apr. 27, 1877	
Blundon, Benjamin A	Mar. 5, 1878	
Blythe, William T	Feb. 9, 1870	
Bolton, Joseph P	May 7, 1885	
Boyer, Harry B	May 26, 1881	
Brandenburg, Fredk. H	Aug. 21, 1877	
Branham, Edward A	Apr. 1, 1873	

Employees in the Weather Bureau July 1, 1902, whose appointment precedes July 2, 1887—Continued.

Name.	Date appointed.	Remarks.
Bronson, Byron H	Nov. 1, 1883	
Buell, Allen	Sept. 16, 1870	Out from April 21, 1878, to August 12, 1878. Out from July 9, 1898, to April 30, 1899.
Byram, John W	Sept. 2, 1878	Out from September 2, 1883, to November 23, 1883.
Carroll, Daniel J	Mar. 3, 1879	
Chaffee, Frank P	Mar. 1, 1879	
Chappel, George M	Mar. 30, 1881	
Clarke, Frederick H	Mar. 3, 1879	
Claveloux, Francis A	July 9, 1878	
Cleaver, Frank M	Aug. 7, 1878	
Cline, Isaac M	July 7, 1882	
Collins, Thomas S	Sept. 4, 1872	Out from July 23, 1878, to May 18, 1879.
Conger, Norman B	Aug. 28, 1878	
Connell, Maurice	Dec. 9, 1884	
Connor, Patrick	Mar. 4, 1876	
Conrad, Frederick W	Nov. 10, 1871	Out from November 18, 1876, to February 28, 1879. Out from June 6, 1889, to January 20, 1890.
Considine, Thomas J	Nov. 1, 1883	
Cox, Henry J	Aug. 1, 1884	
Craig, John	Oct. 20, 1873	
Cronk, Corydon P	July 7, 1882	
Cuthbertson, David	Nov. 16, 1872	
Davis, Albert J	Apr. 20, 1881	Out from July 31, 1893, to September 27, 1897.
Davis, William	June 2, 1877	
Day, Preston C	June 29, 1883	
Day, Walcott L	Oct. 20, 1883	
De Grain, Reinhold F	July 24, 1874	Out from May 5, 1878, to September 3, 1878. Out from February 10, 1880, to April 18, 1884.
Demain, Edward R	July 17, 1880	
Dey, Luther M. (sr.)	Nov. 20, 1874	
Dick, Harvey B	Mar. 18, 1886	
Diehl, Genevra B	July 1, 1887	
Dillon, Edward	Oct. 22, 1881	
Dorman, Louis	Oct. 6, 1880	Out from October 6, 1885, to September 22, 1886. Out from October 20, 1889, to March 25, 1890.
Dosher, Samuel L	May 11, 1883	
Eddey, George W	Jan. 15, 1887	
Eddy, Nathan S	Oct. 5, 1875	
Emery, Eben H	July 30, 1884	
Emery, Samuel C	Apr. 9, 1873	
Evans, Edward A	Dec. 16, 1879	
Fallon, William H	Sept. 8, 1880	
Farish, Franck	Nov. 16, 1883	
Farrington, William H	Aug. 2, 1875	
Fassig, Oliver L	Jan. 12, 1883	
Felger, George W	Sept. 4, 1874	
Fisher, David	Nov. 30, 1880	
Fitzgerald, John	May 20, 1874	
Foy, John T	July 8, 1878	
Fraber, John W	Feb. 9, 1870	
Frankenfield, Harry C	Jan. 4, 1882	
Franklin, George E	July 5, 1878	
Frederick, Julius R	Aug. 1, 1884	Out from May 12, 1885, to October 31, 1890.
Gardiner, I. Gwynn	May 19, 1885	
Garriott, Edward B	May 18, 1874	Out from January 1, 1884, to March 11, 1884.
Gaston, Belle	June 21, 1882	Out from August 5, 1882, to August 31, 1882. Out from January 1, 1883, to July 2, 1883. Out from February 1, 1885, to August 2, 1885. Out from August 13, 1893, to January 11, 1899.
Geddings, Richard M	July 29, 1881	Out from January 16, 1881, to October 31, 1881.
Gibson, Thomas	May 16, 1874	
Gillam, Frank	Aug. 17, 1880	
Glass, Elvin J	Jan. 20, 1882	
Glenn, Samuel W	Oct. 1, 1877	
Gosewisch, Frederic Z	Feb. 29, 1872	
Goucher, Henry	Jan. 15, 1886	
Grant, Robert Q	July 23, 1883	
Gray, James J	Nov. 20, 1885	
Grimes, George E	Jan. 22, 1887	
Grover, John	Mar. 13, 1880	
Hardin, Hal P	Dec. 28, 1886	
Hardinge, Robert M	July 2, 1885	
Hass-Hagen, George	Jan. 7, 1878	
Hay, George W	Dec. 4, 1874	
Hayes, Michael	Oct. 27, 1880	
Heck, George J	Jan. 12, 1882	
Heiskell, Henry L	June 9, 1877	
Henry, Alfred J	July 12, 1878	
Hercus, Alice T	Jan. 3, 1887	
Hersey, Henry B	June 20, 1883	
Hobbs, Everett C	May 2, 1885	

Employees in the Weather Bureau July 1, 1902, whose appointment precedes July 2, 1887—Continued.

Name.	Date appointed.	Remarks.
Holmes, Charles	Oct. 3, 1873	Out from November 16, 1899, to July 15, 1900.
Hunt, George E	Jan. 27, 1882	Out from August 22, 1885, to April 25, 1888.
Hyatt, Robert J	Aug. 27, 1880	Out from September 16, 1888, to January 20, 1889.
Jennings, Thorp B	Oct. 20, 1871	
Jesunofsky, Lewis N	Jan. 21, 1875	
Johnson, Enoch G	July 17, 1882	
Johnson, Fred L	Jan. 5, 1882	
Jones, Charles J	Dec. 21, 1882	
Jones, Edward P	Oct. 11, 1883	
Jones, John H	May 8, 1879	
Kenealy, James	June 24, 1876	
Keough, William	Feb. 1, 1873	
Kimball, Herbert H	July 30, 1884	
King, Thomas H	Aug. 1, 1882	Out from August 9, 1895, to July 6, 1896.
Kinnear, Aaron H	May 18, 1874	
Lamont, John C	July 25, 1872	
Lane, Nathan D	Aug. 11, 1871	Out from August 11, 1876, to February 28, 1879.
Larcombe, Benj. F	Sept. 29, 1883	
Lawton, George E	May 2, 1885	
Lazenby, Richard O	May 27, 1886	
Ling, Charles W	Aug. 27, 1884	Out from July 17, 1888, to February 3, 1889.
Linsley, Julius G	Feb. 1, 1878	
Long, Francis	Aug. 1, 1884	
Loveland, George A	July 6, 1882	
Lyons, Patrick F	Oct. 29, 1875	
McAdie, Alexander G	Jan. 4, 1882	Out from June 12, 1888, to December 11, 1890.
McDermott, Edward	May 2, 1871	Out from April 16, 1894, to April 4, 1897.
McDonough, Patrick	Dec. 27, 1886	
McGann, Edward W	Feb. 29, 1872	
McLean, John J	Dec. 15, 1877	
Marbury, John B	Dec. 16, 1879	
Maring, Delos T	Jan. 16, 1884	
Marvin, Charles F	Sept. 1, 1884	
Mattison, Edward M	Dec. 25, 1874	Out from June 8, 1876, to November 13, 1878.
Maxwell, William D	July 10, 1878	
Melton, James H	Feb. 1, 1878	
Meston, Robert D	Mar. 5, 1872	
Mitchell, Alexander J	Jan. 3, 1882	
Moore, Theodore T	July 3, 1878	
Moore, Willis L	Apr. 21, 1876	
Murphy, Daniel C	Nov. 9, 1871	Out from November 10, 1876, to January 10, 1877.
Neifert, William W	Nov. 27, 1885	
Newman, Fitzhugh	Apr. 9, 1881	
Norrington, William	Mar. 17, 1875	Out from March 17, 1885, to July 20, 1887.
O'Donnell, John J	Oct. 18, 1886	Out from September 1, 1891, to June 9, 1892.
Olds, William J	Jan. 20, 1885	
Pague, Bemer S	Jan. 5, 1886	Out from August 16, 1888, to September 23, 1888.
Passailaigue, Louis F	July 10, 1883	
Patrick, Henry R	Jan. 5, 1886	
Patrick, William	Aug. —, 1871	Out from August 12, 1886, to January 10, 1887. Out from August 1, 1893, to July 31, 1895.
Pennywitt, Henry	Feb. 17, 1871	Out from August 6, 1876, to March 4, 1880. Out from September 27, 1874, to January 6, 1875.
Penrod, Hiram J	Mar. 4, 1871	Out from August 1, 1890, to June 15, 1891. Out from July 9, 1891, to September 29, 1891. Out from April 6, 1893, to February 29, 1896.
Phillips, William F. R	July 6, 1883	
Piercy, Joseph C	Oct. 14, 1880	
Pindell, Lewis M	May 18, 1878	
Plummer, William	Feb. 1, 1883	Out from March 1, 1883, to December 5, 1883.
Pugh, Thomas O	Dec. 8, 1881	
Purssell, Ulysses G	July 9, 1885	
Randolph, Frederick J	Jan. 6, 1879	
Reeder, George	Dec. 16, 1885	
Richardson, Herbert W	Jan. 19, 1886	
Ridgway, Frank	Jan. 25, 1879	Out from January 25, 1884, to October 8, 1884.
Robinson, Jesse H	Mar. 6, 1872	
Roche, Henry H	Dec. 24, 1886	
Ryker, John N	July 7, 1882	
Salisbury, George N	July 3, 1883	
Schneider, Charles F	Dec. 28, 1885	
Scott, George W	Jan. 2, 1878	Out from January 5, 1883, to December 22, 1886.
Seyboth, Robert	Oct. 21, 1870	
Sherier, Julius M	Nov. 2, 1885	
Simms, Alfred F	July 6, 1882	
Simons, William U	Apr. 30, 1872	Out from July 12, 1885, to September 24, 1886.
Simpson, Elmer E	Dec. 16, 1879	
Slaughter, J. Pemberton	Aug. 17, 1883	
Smith, George W	July 8, 1878	
Smith, John W	June 12, 1874	
Spencer, Belle P. N	July 1, 1883	

Employees in the Weather Bureau July 1, 1902, whose appointment precedes July 2, 1887—Continued.

Name.	Date appointed.	Remarks.
Stewart, Charles	June 30, 1883	
Stewart, John C	Apr. 2, 1881	
Stewart, Oscar D	Sept. 4, 1878	
Stockman, William B	Dec. 1, 1877	
Strong, Charles M	Jan. 16, 1884	
Sullivan, John	Jan. 22, 1882	
Tarr, Leonard M	July 3, 1883	
Thompson, Arthur	Aug. 20, 1885	
Thompson, Edwin C	July 16, 1884	
Thompson, E. Herbert	Apr. 24, 1880	
Todd, George T	Jan. 4, 1887	
Townsend, Theodore F	Mar. 1, 1871	
Tuch, Charles B	Apr. 11, 1879	
Von Herrmann, Charles T	Nov. 17, 1884	
Vose, Elisha C	Dec. 22, 1885	
Walz, Ferdinand J	May 12, 1885	
Watson, James M	Apr. 2, 1870	
Welsh, Lucius A	Aug. 2, 1873	
Whiteside, James L	July 17, 1880	
Widmeyer, James I	Dec. 4, 1885	
Williams, Frank T	Apr. 25, 1881	
Williams, Henry E	Mar. 24, 1876	
Williams, John R	Oct. 7, 1872	
Willson, George H	Apr. 24, 1880	
Wilson, Wilford M	Sept. 25, 1885	
Wood, Peter	July 17, 1880	

TITLES OF POSITIONS AND CLASSES OF EMPLOYEES.

Titles of positions and classes of employees in the U. S. Department of Agriculture, indicating the nature of their several occupations.

Plant physiologists.
Plant pathologists.
Botanists.
Pomologists.
Agrostologists.
Cerealists.
Mycologists.
Crop culturists.
Pharmacologists.
Horticulturists.
Gardener.
Gardener's assistants.
Foresters.
Field assistants in forestry.
Dendro-chemists.
Collaborators in forestry.
Photographers.
Soil physicists.
Soil scientists.
Soil analysts.
Assistants in soil survey.
Drainage engineers.
Tobacco expert specialists.
Scientific aids.
Scientific assistants in physics as applied to soils.
Chemists.
Assistant chemists.
Biochemists.
Chemical tabulators.
Scientific assistants in analytical chemistry.
Scientific assistants in agricultural chemistry.
Scientific assistants in industrial chemistry.
Scientific assistants in botany.
Scientific assistants in plant physiology and pathology.

Scientific assistants in horticulture.
Scientific assistants in bacteriology.
Scientific assistants in forestry.
Scientific assistants in physiology and nutrition of man.
Scientific assistants in animal pathology.
Scientific assistants in animal production and dairying.
Scientific assistants in rural engineering, especially as applied to road making.
Scientific assistants in rural engineering, especially as applied to irrigation.
Scientific assistants in practice of agriculture.
Scientific assistants in agricultural statistics.
Student assistants.
Entomologists.
Assistant entomologists.
Scientific assistants in entomology.
Scientific assistants in ornithology and mammalogy.
Ornithologists and mammalogists.
Statisticians.
Compilers in statistics.
Tabulators of statistics.
Irrigation engineers.
Irrigation assistants.
Irrigation specialists.
Public roads engineers.
Public roads constructors.
Road material engineers.
Zoologists.
Scientific assistants in zoology.
Assistants in biochemic investigations.
Veterinary inspectors in animal industry.
Meat inspectors in animal industry.
Assistant inspectors in animal industry.
Vessel inspectors in animal industry.
Live stock agents in animal industry.
Stock examiners in animal industry.
Taggers in animal industry.
Microscopists in animal industry.
Assistant microscopists in animal industry.
Microscope and other instrument repairers in animal industry.
Animal husbandry specialists in animal industry.
Professors of meteorology in the Weather Bureau.
Meteorologists in the Weather Bureau.
Medico-climatologists in the Weather Bureau.
Forecast officials in the Weather Bureau.
Local forecast officials in the Weather Bureau.
Observers in the Weather Bureau.
Section directors in the Weather Bureau.
Station agents in the Weather Bureau.
Messenger boys on stations in the Weather Bureau.
Skilled artisans in the Weather Bureau.
Batterymen in the Weather Bureau.
Repairmen in the Weather Bureau.
River observers in the Weather Bureau.
Rainfall observers in the Weather Bureau.
Cotton-region observers in the Weather Bureau.
Sugar and rice observers in the Weather Bureau.
Corn and wheat observers in the Weather Bureau.
Fruit and wheat observers in the Weather Bureau.
Storm-warning displaymen in the Weather Bureau.
Clerks.
Bookkeepers.
Copyists.
Typewriters.
Stenographers and typewriters.
Editors.
Editorial clerks.
Proof readers.
Translators.
Artists.

Modelers.
Illustrators.
Engravers.
Lithographers.
Compositors.
Printers.
Pressmen.
Folders and feeders in printing office.
Library clerks.
Library cataloguers.
Scientific assistants in library science.
Publication and document folders and mailers.
Frank counters.
Telegraph and telephone operators.
Electricians.
Steam engineers.
Firemen.
Assistant firemen.
Machinists.
Skilled mechanics.
Plumbers.
Blacksmiths.
Carpenters.
Painters.
Skilled laborers.
Messengers.
Assistant messengers.
Watchmen.
Mere unskilled manual laborers, including charwomen.

REGULATIONS GOVERNING EMPLOYEES IN THE U. S. DEPARTMENT OF AGRICULTURE.

By the provisions of the Civil Service act approved January 16, 1883, and the rules of the U. S. Civil Service Commission approved by the President, all positions in the U. S. Department of Agriculture, except those of mere manual, unskilled laborers, including charwomen, are now embraced in the classified civil service, and appointments thereto can now be made only from certificates issued by the U. S. Civil Service Commission, except in the cases of special agents and experts.

All persons seeking information respecting the classified civil service and examinations for positions therein should address the U. S. Civil Service Commission, Washington, D. C. A manual of examinations for the classified civil service of the United States is published by the U. S. Civil Service Commission for the information and guidance of all persons interested therein.

Any person holding an appointment to a position in any other Department or officially connected with any other branch of the Government service will not, while holding such appointment, be employed in any capacity, even temporarily, in the U. S. Department of Agriculture.

To every person appointed to any position in the U. S. Department of Agriculture a written appointment, signed by the Secretary (or Acting Secretary) of Agriculture, will be issued, stating the title or name of the position to which appointed and describing in general terms the character of the service to be performed by and specifying the salary or the rate of compensation to be paid to the person so appointed and the specific roll or fund provided in the act making appropriations for the Department of Agriculture from which paid.

Every appointee will be required to take an oath (or affirmation) of office in the form prescribed by law before entering upon his duties, and file the same, together with a statement of legal residence, post-office address, and personal record, with the Appointment Clerk of the Department, on a form provided by the Department.

In every case in which the issue of a new appointment becomes necessary, as in promotions, reappointments, transfers, and changes of official designation, a new oath and a statement of personal record will be required, unless otherwise directed in the appointment.

The oath of office of appointees to positions in the United States Department of Agriculture may be taken before any officer having an official seal, with authority to administer oaths either by United States statutes or by local municipal law, and it must be properly certified under the hand and seal of such officer. The oath of office may also be taken before the Chief Clerk of the United States Department of Agriculture or before the chief clerk of any Bureau thereof.

Neither salary nor other emoluments will be paid to any employee until the required oath of office shall have been filed with the Appointment Clerk of the Department, nor until the appointee shall have reported for duty according to his instructions. If a specific date is named upon which the appointment is to take effect, salary will not begin until that date, although the oath may have been taken earlier.

REGULATIONS GOVERNING PROMOTIONS, ETC., IN THE U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF U. S. CIVIL SERVICE COMMISSION,
Washington, D. C., December 1, 1896.

In pursuance of the requirements of section 7 of "An act to regulate and improve the civil service of the United States," approved January 16, 1883, and in conformity with Rule XI of the revision of the Civil Service Rules promulgated by the President on the 6th day of May, 1896, the following regulations governing promotions in the departmental service of the Department of Agriculture have been formulated by the Civil Service Commission after consultation with the Secretary of Agriculture, and are hereby promulgated:

Regulation I.

SECTION 1. All vacancies above those in the lowest class of any grade not filled by reinstatement, transfer, or reduction shall be filled by promotion: *Provided*, That if there is no person eligible for promotion, or if the vacant position requires the exercise of technical or professional knowledge, it may be filled through certification by the Civil Service Commission.

SEC. 2. Except as provided in section 1 of this regulation, a vacancy in any class shall be filled by the promotion of an eligible in the next lower class of the same Bureau, Division, or Office. When such vacancy exists the Board of Promotion Review shall certify to the Secretary of Agriculture the names of the three eligibles in the Bureau, Division, or Office having the highest records of efficiency, and from these names the Secretary of Agriculture shall make his selection: *Provided*, That if there shall be in the Bureau less than three eligibles in the class next below that in which the vacancy exists, the Board of Promotion Review shall certify as many in addition of the highest eligibles in the corresponding class of the other Bureaus as may be necessary to make a full certification.

Regulation II.

SECTION 1. No person shall be promoted to any grade from which he is barred by the age limitations prescribed by the Civil Service Rules.

SEC. 2. No person whose record of efficiency is below 85 per cent of the possible maximum rating of his class or grade shall be eligible for promotion.

SEC. 3. No person occupying a position below the grade of clerk-copyist shall be promoted to that grade until he shall have been employed two years in the departmental service and shall have passed, with an average percentage of 70 or over, the examination prescribed by the Commission.

Regulation III.

SECTION 1. The chief clerk of each Bureau, under the direction of the head thereof, shall keep a record of the efficiency of all employees under his supervision, and a similar record of employees not assigned to any Bureau shall be kept by the Chief Clerk of the Department.

SEC. 2. The record of efficiency shall be kept on such forms as may be prescribed by the Commission after consultation with the Secretary of Agriculture, and shall embrace the elements which are essential to a fair and accurate determination of the relative merits of employees.

SEC. 3. A record of those eligible for promotion shall be kept by the Board of Promotion Review. The board shall have access to efficiency records, and may at any time call for a transcript of the same.

SEC. 4. The efficiency reports made by the chiefs of the several Bureaus, Divisions, and Offices of the Department of Agriculture respecting the value of the personal services in the Department of each person serving under them, and filed with the Appointment Clerk for the Chief Clerk of the Department, shall be the basis of all promotions, demotions, and continuations on the rolls of the Department.

SEC. 5. The following shall be the form of efficiency report to be used in the Department of Agriculture:

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., ..., *189...*

TO THE CHIEF OF THE .....

You are directed to report upon the following-named person, as the questions herein propounded may require, and to file the report with the Appointment Clerk for the Chief Clerk.

J. STERLING MORTON, *Secretary.*

EFFICIENCY REPORT.

M..... is employed under your supervision. This person's salary is $..... per annum.

Upon what character of work is this person generally employed? Is it clerical? Supervisory? Routine? Is it of a varied and exceptional character? Does it involve original thought, consideration, or investigation? If it is skilled labor, state the kind, and whether it is supervisory or routine. If it is that of messenger, watchman, charwoman, or mere laborer, state the fact.

.....

How high on a scale of 10 do you rate the quality of this person's work? .....

How high on a scale of 10 do you rate the quantity of work per month done by this person? .....

How high on a scale of 10 do you rate the punctuality of this person? .....

How high on a scale of 10 do you rate the deportment of this person? .....

How many days absent from duty on account of sickness during the six months last past? .....

How many days absent from duty otherwise than on account of sickness during the six months last past? ..... On account of annual leave? ..... Without leave? ..... Furloughed? .....

Does this person show, in your opinion, any special fitness for work of a higher intellectual character than that to which assigned?

.....

Have you any further statement to make respecting this person? If so, make it here. .....

.....

(Signed) .....

No. ..... Chief of the .....

(MEMORANDUM RESPECTING THIS PERSON, COMPILED FROM THE RECORDS OF THE DEPARTMENT.)

First appointed ....., 18 , at a salary of $..... per annum. .....

.....

.....

Classified civil-service record: .....

.....

.....

SEC. 6. An examination into the relative efficiency of employees, as shown by the efficiency record hereinbefore provided for, and such further tests as the Commission may deem necessary, shall constitute an examination for promotion from one class to another class. No person, except as herein provided, shall be eligible for promotion until he shall have passed such an examination.

SEC. 7. Examinations for promotion from one grade to another grade shall be conducted by the Board of Promotion Examiners at such times as may be fixed by the Commission.

SEC. 8. Efficiency reports shall be called for by the Chief Clerk immediately before the termination of the first half of the fiscal year, and also immediately before the termination of the fiscal year, and may be called for at such other times as the interests of the Department seem to require.

JOHN R. PROCTER,
President Civil Service Commission.

EXECUTIVE ORDER.

All officers and employees of the United States of every description, serving in or under any of the Executive Departments, and whether so serving in or out of Washington, are hereby forbidden, either directly or indirectly, individually or through associations, to solicit an increase of pay or to influence or attempt to influence in their own interest any other legislation whatever, either before Congress or its committees, or in any way save through the heads of the Departments in or under which they serve, on penalty of dismissal from the Government service.

(Signed) THEODORE ROOSEVELT.

WHITE HOUSE, *January 31, 1902.*

AMENDMENT TO THE CIVIL SERVICE RULES.

In the exercise of the power vested in the President by the Constitution and by virtue of the one thousand seven hundred and fifty-third section of the Revised Statutes, and of the Civil Service act approved January 16, 1883, Civil Service Rule XI is hereby amended by adding at the end thereof the following section:

5. No recommendation for the promotion of any employee in the classified service shall be considered by any officer concerned in making promotions except it be made by the officer or officers under whose supervision or control such employee is serving; and such recommendation by any other person, with the knowledge and consent of the employee, shall be sufficient cause for debarring him from the promotion proposed, and a repetition of the offense shall be sufficient cause for removing him from the service.

(Signed) THEODORE ROOSEVELT.

WHITE HOUSE, *July 3, 1902.*

REGULATIONS GOVERNING APPOINTMENT TO POSITIONS OF MERE UNSKILLED LABORER UNDER DEPARTMENT OF AGRICULTURE IN DISTRICT OF COLUMBIA.

In the exercise of power vested in the President by the Constitution and by section 1753 of the Revised Statutes, the following regulations governing appointment to positions of mere manual unskilled laborer under the Department of Agriculture in the District of Columbia, having been recommended by the Secretary of Agriculture and the Civil Service Commission, are hereby approved and promulgated, to be effective from and after July 2, 1902:

1. These regulations shall not have the effect of bringing positions of mere laborer within the provisions of the act of January 16, 1883, known as the Civil Service act, or of the rules in pursuance thereof; but the system of appointments hereby established shall be separate and distinct from the classified service.

2. No person shall be appointed to, or employed in, any position of mere laborer under the Department of Agriculture in the District of Columbia except in accordance with these regulations.

3. The Secretary of Agriculture shall appoint a board of labor employment of not less than three members, who shall be officers or employees of the Department of Agriculture, and who shall be divided as nearly as practicable between different political parties.

4. Each applicant shall make application on a form prescribed by the board of labor employment and approved by the Civil Service Commission, showing his age, physical condition, and other qualifications for the performance of mere manual labor, as indicated by his past occupations. The form of application shall be accompanied by certificates, or vouchers, from three reputable citizens who have knowledge of and are competent to testify as to the applicant's character and qualifications for performing manual labor.

5. Political or religious affiliations of applicants shall not be given any consideration whatever, nor shall political indorsements be received or entertained.

6. Applications of persons over 65 years of age will not be considered, except of honorably discharged United States soldiers or sailors of the civil war or of the Spanish-American war and of those entitled to the benefits of section 1754, Revised Statutes.

7. Applications shall not be received from persons who are badly crippled or deformed, or from persons who are not citizens of the United States; applicants who claim citizenship through naturalization shall be required to submit to the board documentary proof of their naturalization.

8. Applications shall be received by the board of labor employment at any time. On the 1st of January and the 1st of July of each year the board shall determine the relative fitness of each applicant who has filed his application in complete form within the six months preceding; the rating or determination of relative fitness shall be made on a scale of 100 and based upon a careful consideration of the applicant's age, his physical qualifications for performing mere manual labor, and his ability and adaptability to perform such labor, special consideration being given any former service as laborer in the Department. In rating an applicant no credit shall be given for any qualifications which he may possess other than those for the performance of manual labor, as above enumerated. The fact that an applicant can not read and write shall not be considered in determining his rating. Whenever in any case the board is unable to determine satisfactorily the rating of an applicant upon the information furnished in connection with the application, it may secure such further information as it may desire in respect to the applicant's character or ability, and may summon the applicant to appear personally before the board or its representative: *Provided*, That all information or matter which is given any consideration in determining the rating shall be reduced to writing and made a part of the applicant's papers. All applicants who receive a rating of 70 or more shall be deemed eligible. Whenever it may be necessary, in order to supply qualified persons for appointment, the board may at any time between January 1 and July 1 rate all applicants whose applications may be at such time on file and unrated.

9. As soon as the board has completed the rating of applicants for any period, as provided in section 8 of these regulations, it shall enter upon the register of eligibles the names of all those whom it has determined, in accordance with said section, to be eligible for the performance of mere manual labor, arranged in the order of relative fitness, with the highest first: *Provided*, That the names of eligibles who are entitled to preference under section 1754 of the Revised Statutes shall be placed at the head of the register in the order of their ratings. Separate registers of eligibles shall be kept, one for males and one for females. The period of eligibility shall be one year from the date on which the name of an eligible is entered on the register.

10. Whenever the Secretary of Agriculture desires to fill, by original appointment, an existing vacancy in the position of mere manual laborer, upon his request the board of labor employment shall certify to him from the male or female register, as indicated in the request, the three names at the head thereof which have not been three times certified. Of the three names certified the Secretary of Agriculture shall select one for appointment, and if, at the time of the selection, there are more vacancies than one, he may select more than one. The policy of the Department will be to select for appointment the highest of the three names certified, unless, for some reason satisfactory to the Department, it is deemed best to select one of the others. A person selected for appointment shall receive a certificate for a probationary period of six months, at the end of which period, if his conduct and capacity are satisfactory to the Secretary of Agriculture, his retention in the service shall be equivalent to his absolute appointment; but if his conduct or capacity be not satisfactory, he shall be notified that he will not receive absolute appointment because of such unsatisfactory conduct or want of capacity, and such notification shall discharge him from the service. Removal during the probationary period or after absolute appointment shall be made without any regard to political or religious affiliations. Whenever a person is separated from the position of mere manual laborer for any reason he shall be given what may be known as a separation card, upon which shall be entered a statement of the reasons for his separation and of the character of service rendered by him.

11. Persons appointed through certification by the board of labor employment under these regulations shall not be assigned to the performance of any clerical duty or of any duty properly belonging to any position classified under the civil-service law; and the compensation paid to any person appointed under these regulations shall not exceed $50 per month or $600 per annum.

12. The records of the board of labor employment shall at all times be open to the inspection of the Civil Service Commission or its authorized representatives.

13. In connection with his monthly report of changes to the Commission the Secretary of Agriculture shall certify whether any person holding a position of mere manual laborer under these regulations has been assigned to clerical duty or any other duty properly belonging to a position classified under the Civil Service law.

14. The Civil Service Commission, whenever it shall find that any person is holding a position contrary to the provisions of these regulations, shall, after notice to the person affected and an opportunity for explanation or other statement, certify information of the fact of such irregularity to the Secretary of Agriculture, and then if such person be not dismissed within thirty days, to the disbursing and auditing officers through whom the salary or wages of such person is by law required to be paid; and thereafter such disbursing or auditing officers shall not pay or permit to be paid to such person any salary or wages which accrue after such certificate has been received by him.

15. These regulations may be amended either by the President or by the concurrent action of the Secretary of Agriculture and the Civil Service Commission.

THEODORE ROOSEVELT,
President.
JAMES WILSON,
Secretary of Agriculture.

Dated July 2, 1902.

REGULATION 9 AMENDED.

Section 9 of the regulations governing appointment to positions of mere unskilled laborer under the Department of Agriculture in the District of Columbia is hereby amended by inserting after the word "males" the words "between the ages of 14 and 21 years, and one for males between the ages 21 and 65 years," and add after the word "females" the following words: "Between the ages of 14 and 21 years, and one for females between the ages of 21 and 65 years," so that the section will read as follows when so amended:

"9. As soon as the board has completed the ratings of applicants for any period, as provided in section 8 of these regulations, it shall enter upon the register of eligibles the names of all those whom it has determined, in accordance with said section, to be eligible for the performance of mere manual labor, arranged in the order of relative fitness, with the highest first: *Provided*, That the names of eligibles who are entitled to preference under section 1754 of the Revised Statutes shall be placed at the head of the register in the order of their ratings. Separate registers shall be kept—one for males between the ages of 14 and 21 years, and one for males between the ages of 21 and 65 years, and one for females between the ages of 14 and 21 years, and one for females between the ages of 21 and 65 years. The period of eligibility shall be one year from the date on which the name of an eligible is entered on the register.

(Signed) JAMES WILSON,
Secretary of Agriculture.

(Signed) W. D. FOULKE,
Acting President, U. S. Civil Service Commission.

August 29, 1902.

Blank application forms for appointment to the position of mere unskilled laborer may be obtained by applying to the U. S. Department of Agriculture.

REPORT OF THE STATISTICIAN.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF STATISTICS,
Washington, D. C., November 1, 1902.

SIR: I have the honor to submit herewith a report of the work of the Division of Statistics for the fiscal year ended June 30, 1902.

Respectfully,

JOHN HYDE,
Statistician.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

The work of the Division of Statistics has consisted mainly, as in past years, of the preparation of reports relative to the extent and geographical distribution of the area of production of the principal products of the soil, the condition and prospects of the different crops during the growing season, and the quantity, quality, and disposition of the product harvested, together with the latest information concerning the crops of such foreign countries as enter into competition with the United States in the markets of the world.

No amplification of the scope of the work was practicable until an increased appropriation should provide for the employment of a larger number of experts and compilers.

While, as already stated, there could be no immediate enlargement of the scope of the work of this Division, arrangements have been made for the resumption of the reports on live stock and on tobacco, which had been temporarily suspended pending the publication of those of the Census.

The results of such work as the Division has been engaged in, other than that of crop reporting, have been embodied in publications on "Statistics on the fruit industry of California," "Wheat ports of the Pacific coast," "The future demand for American cotton," and "The cotton-seed industry," with numerous statistical articles on various subjects appearing from time to time in the Crop Reporter.

With a view to further improving the crop-reporting service of the Division, two additional field agents have been appointed, and the statistical expert, who has for some years had charge of the crop statistics of foreign countries competing with the United States, has been sent to London, England, where he is in closer touch with the statistical offices of the different European Governments, whose reports, along with the most authoritative commercial intelligence of interest to American agriculturists, he transmits to Washington by mail or cable immediately upon their becoming available.

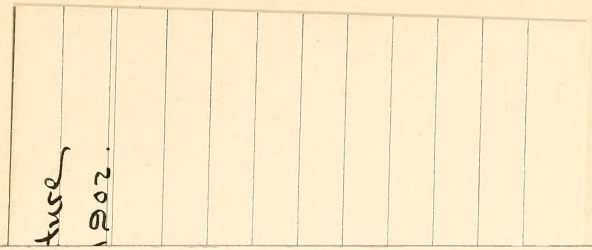
In cooperation with the State Agricultural College of Minnesota, a statistical investigation is being conducted by the Division of Statis-

tics into methods of farming, the results of which will have an important bearing on such questions as the relative profitableness of crops, the economical utilization of farm labor, etc.

RECOMMENDATION.

Another year has passed without the Division having those enlarged opportunities for usefulness which the possession of a bureau organization would give it. As pointed out in the Statistician's last annual report, the fact that the Department's crop-reporting service, numbering nearly 250,000 persons, or five times as many as the Census enumerators, is a voluntary service, inevitably results in some lack of appreciation of its magnitude and of the amount of work involved, not only in tabulating its reports, numbering about 2,500,000 per annum, but also in maintaining the organization itself. A divisional organization can not utilize to the greatest possible advantage the possibilities of usefulness which the possession of this great corps of agricultural correspondents places within its reach. On the other hand, the more elastic organization of a bureau, with that larger clerical force and increased number of statistical experts, could not fail to make the statistical work of the Department more fully commensurate with the great agricultural interests of the country.

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Bureau of Entomology and Plant Quarantine